

# NUCLEAR SCIENCE ABSTRACTS

Vol. 7, No. 15, August 15, 1953

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## ERRATUM

NSA, Vol. 7, No. 11. On p. 2 of Index, G. B. Ehrstiansen should be G. B. Khristiansen.

## CALENDAR OF MEETINGS

Suggestions for additions to this list will be welcomed and should be sent with all pertinent information to the Cataloging Branch, Technical Information Service, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

September 9-12, 1953

CONFERENCE ON NUCLEAR ENGINEERING. Sponsored by: University of California, Berkeley, California.

Inquiries should be addressed to: Professor R. A. Fayram, 208 Mechanics Building, University of California, Berkeley 4, California.

October 29-30, 1953

CONFERENCE ON ATOMIC ENERGY, Waldorf-Astoria Hotel, New York. Sponsored by: National Industrial Conference Board.

Inquiries should be addressed to: R. Maxil Ballinger, Division of Business Practices, National Industrial Conference Board, 247 Park Avenue, New York 17, N. Y.

June 20-25, 1954

NUCLEAR ENERGY MEETING, University of Michigan, Ann Arbor, Michigan. Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineering, Ann Arbor, Michigan.



# REPORTS REFERENCE LIST

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The abstract number for each report is listed at the upper right of the entry. If the number bears an asterisk, the report is title listed only and no abstract is included.

## USAEC DECLASSIFIED REPORTS

- AECD-3524 4330  
Radiation Lab., Univ. of Calif., Berkeley  
CHEMISTRY DIVISION QUARTERLY REPORT [FOR]  
SEPTEMBER, OCTOBER, [AND] NOVEMBER 1952. Dec.  
31, 1952. Decl. with deletions May 12, 1953. 66p. (AECD-  
3524; UCRL-2089)
- AECD-3525 4465  
Livermore Research Lab., Calif. Research and Develop-  
ment Co.  
SOME STUDIES OF THE PRODUCTS OF THE HIGH-  
ENERGY FISSION PROCESS. M. Lindner and R. N. Osborne.  
Dec. 23, 1952. Decl. with deletions June 1, 1953. 25p.  
(AECD-3525)
- AECD-3526 4453  
Oak Ridge National Lab.  
THE KINETICS OF THE CIRCULATING-FUEL NUCLEAR  
REACTOR. W. K. Ergen. Mar. 30, 1953. Decl. June 4,  
1953. 39p. (AECD-3526; CF-53-3-231)
- AECD-3527 4364  
Carbide and Carbon Chemicals Co. (K-25)  
THE ROLE PLAYED BY EDDY DIFFUSION IN TURBULENT  
FLOW: LITERATURE SURVEY. R. C. Bacon. Issued  
Sept. 28, 1951. Decl. with deletions June 1, 1953. 45p.  
(AECD-3527; K-816)
- AECD-3528 4306  
Mound Lab.  
STUDIES ON CELL DIVISION. 1. ALPHA RADIATION  
AS A DIVISION INHIBITING AGENT. E. S. Spoerl and  
R. J. Balske. Apr. 28, 1953. Decl. June 1, 1953. 35p.  
(AECD-3528; MLM-820)
- AECD-3530 4454  
[Knolls Atomic Power Lab.]  
THE THERMAL TEST REACTOR OF THE KNOLLS  
ATOMIC POWER LABORATORY. Lewi Tonks. [nd]  
Decl. with deletions June 9, 1953. 23p. (AECD-3530)

## USAEC UNCLASSIFIED REPORTS

- AECU-2571 4302  
Los Alamos Scientific Lab.  
ABSORPTION OF LIQUID HTO AND HTO VAPOR THROUGH  
THE SKIN OF MAN. Ernest A. Pinson, Ernest C. Anderson,  
and Virginia Lotz. June 1952. 17p. (AECU-2571; LADC-  
1326)
- AECU-2572 4315  
[Sandia Corp.]  
MEASUREMENT OF SLOW NEUTRONS AND COEXISTING  
RADIATIONS. P. S. Harris. [1953] 20p. (AECU-2572;  
LADC-1438)

- AECU-2573 4378  
Los Alamos Scientific Lab.  
THE PREPARATION OF SAMARIUM METAL. E. I.  
Onstott. [1953] 3p. (AECU-2573; LADC-1441)
- AECU-2574 4419  
Atomic Energy Project, Univ. of Calif., Los Angeles  
DEVELOPMENT OF CHEMICAL SYSTEMS APPLICABLE  
TO PRODUCTION OF THE ARMY TACTICAL AND  
ORGANIZATIONAL DOSIMETERS: QUARTERLY REPORT  
[FOR] OCTOBER 1, 1952-JANUARY 1, 1953. George V.  
Taplin, Clayton H. Douglas, Sanford C. Sigoloff, Donald  
Wales, Donald Paglia, and Charles Heller. Jan. 1, 1953.  
49p. (AECU-2574; Quarterly Report 2)
- AECU-2575 4338  
Los Alamos Scientific Lab.  
A CONTINUOUS TITRATION METHOD FOR CHOLINESTER-  
ASE DETERMINATIONS. Jean Captain Sabine. [1953] 12p.  
(AECU-2575; LADC-1416)
- AECU-2576 4396  
Knolls Atomic Power Lab.  
THE USE OF SELF-EQUILIBRATING EIGENFUNCTIONS  
IN SOLUTION OF SOME BEAM PROBLEMS. G. Horvay  
and J. S. Born. [1953] 18p. (AECU-2576)
- AECU-2577 4479  
Los Alamos Scientific Lab.  
DETERMINATION OF INELASTIC COLLISION CROSS  
SECTIONS. [John R. Beyster.] [nd] 13p. (AECU-2577;  
LADC-1436)
- AECU-2578 4303  
Pennsylvania Univ. School of Medicine  
THE MITOCHONDRIA OF BACTERIA. Stuart Mudd. [1953]  
27p. (AECU-2578)
- AECU-2588 4437  
[Purdue Research Foundation]  
INDICATIONS OF THE INTERACTION OF ELECTRIC  
FIELD GRADIENTS AND NUCLEAR ELECTRIC QUADRU-  
POLE MOMENTS IN ANGULAR CORRELATION. Rolf M.  
Steffen. [1953] 6p. (AECU-2588)
- BNL-1359 4455  
Brookhaven National Lab.  
[SELECTION OF MATERIALS AND EQUIPMENT FOR  
REACTORS.] PART 5. RESEARCH USE OF A NUCLEAR  
REACTOR. Marvin Fox. [1953] 11p. (BNL-1359)
- BNL-1401 4316  
Brookhaven National Lab.  
THE PROTECTIVE EFFECT OF INTRAOCULAR TRANS-  
PLANTS UPON COBALT-60 GAMMA IRRADIATED MICE.  
Richard D. Stoner and William M. Hale. [1952] 20p.  
(BNL-1401)
- BNL-1405 4324  
Brookhaven National Lab.  
STUDIES WITH RADIOPHOSPHORUS IN DROSOPHILA. 3.



- THE TURNOVER OF PHOSPHORUS IN ADULT D. MELANOGASTER AND D. SIMULANS. Robert C. King. [1953] 11p. (BNL-1405) 4307
- BNL-1406  
Brookhaven National Lab.  
STUDIES WITH RADIOPHOSPHORUS IN DROSOPHILA. 2. THE EFFECT OF  $P^{32}$  TREATMENT UPON DEVELOPMENT. Robert C. King. [1953] 13p. (BNL-1406)
- BNL-1409 4304  
Brookhaven National Lab.  
THE FORMATION OF TETANUS ANTITOXIN BY SPLEEN AND LYMPH NODE INTRAOCULAR TRANSPLANTS. William M. Hale and Richard D. Stoner. [1953] 23p. (BNL-1409)
- BNL-1410 4371  
Brookhaven National Lab.  
A COMBINATION HIGH VACUUM AND PRESSURE VALVE. Edward G. Reilly. [1953] 3p. (BNL-1410)
- BNL-1411 4435  
Brookhaven National Lab.  
LONG LIVED DELAYED NEUTRONS FROM FISSION. J. W. Kunstadter, J. J. Floyd, and L. B. Borst. [Mar. 27, 1953] 14p. (BNL-1411)
- BNL-1412 4325  
Brookhaven National Lab.  
INSULIN AND THE RELATION BETWEEN PHOSPHATE TRANSPORT AND GLUCOSE METABOLISM. Jacob Sacks and F. Marott Sinex. [1952] 14p. (BNL-1412)
- BNL-1414 4305  
Brookhaven National Lab.  
A METHOD FOR ERADICATION OF THE MITE, MYOCOPTES MUSCULINUS FROM LABORATORY MICE. Richard D. Stoner and William M. Hale. [1953] 6p. (BNL-1414)
- CF-53-2-266 4438  
Oak Ridge National Lab.  
GAMMA-RAY TOTAL MASS ABSORPTION COEFFICIENTS. M. K. Hullings. Feb. 12, 1953. 5p. (CF-53-2-266)
- COO-126 4344  
Iowa State Univ.  
STRUCTURES AND PROPERTIES OF INTERMETALLIC COMPOUNDS; PROGRESS REPORT FOR THE PERIOD DECEMBER 1, 1952 TO MAY 31, 1953. Norman Charles Baenziger, J. W. Nielsen, and E. J. Duwell. June 1, 1953. 11p. (COO-126)
- DP-19 4373  
Du Pont de Nemours, E. I., and Co., Engineering Dept.  
SAVANNAH RIVER PLANT STACK GAS DISPERSION AND MICROCLIMATE SURVEY. L. L. Falk, C. B. Cave, W. R. Chalker, J. A. Greene, and C. W. Thorngate. Jan. 1953. 155p. (DP-19)
- HW-27620 27620  
Hanford Works  
THE ABSORPTION AND TRANSLOCATION BY PLANTS OF RADIOACTIVE ELEMENTS FROM "JANGLE" SOIL. A. A. Selders, J. H. Rediske, and R. F. Palmer. Feb. 16, 1953. 12p. (HW-27620)
- IDO-24010 4374  
Idaho Operations Office, AEC  
RADIOACTIVE WASTE REMOVAL IN A TRICKLING FILTER SEWAGE PLANT. A. L. Biladeau. May 1953. 12p. (IDO-24010)
- ISC-259(rev.) 4357  
Ames Lab.  
THE INFRARED SPECTRA OF AROMATIC COMPOUNDS. 1. EVIDENCE INDICATING INTRAMOLECULAR HYDROGEN BONDING BETWEEN SUBSTITUENT GROUPS AND RING HYDROGENS. M. Margoshes and V. A. Fassel. Apr. 15, 1953. 25p. (ISC-259(rev.))
- ISC-334 4354  
Ames Lab.  
THE KINETICS OF THE CERIUM(IV)-CHLORIDE REACTION: THE CERIUM(IV) THALLOUS REACTION IN THE PRESENCE OF CHLORIDE. Frederick R. Duke and Curtis E. Borchers. Apr. 17, 1953. 12p. (ISC-334)
- ISC-343 4358  
Ames Lab.  
A NEW APPROACH TO DIRECT READING SPECTRO-CHEMICAL ANALYSIS. Richard K. Brehm and Velmer A. Fassel. May 6, 1953. 16p. (ISC-343)
- LA-1544 4308  
Los Alamos Scientific Lab.  
THE RELATIVE BIOLOGICAL EFFECTIVENESS OF TRITIUM IN DEPRESSING IRON UPTAKE IN RATS. John Furchner, John Storer, and Virginia Lotz. Mar. 1953. 19p. (LA-1544)
- MTA-22 4466  
Livermore Research Lab., Calif. Research and Development Co.  
ENERGY-DEPENDENCE OF THE CROSS SECTION FOR THE REACTION  $C^{12}(\alpha, n)C^{11}$ . M. Lindner and R. N. Osborne. Jan. 28, 1953. 8p. (MTA-22)
- MTA-29 4331  
California Research and Development Co.  
CONCERNING THE CORRELATION OF SOLID METAL AND NON-ELECTROLYTE SOLUBILITIES. P. L. Auer. Apr. 14, 1953. 12p. (MTA-29)
- MTA-32 4362  
Livermore Research Lab., Calif. Research and Development Co.  
DESIGN OF PIPING SYSTEMS AND CONTROLS FOR LIQUID NITROGEN AND SIMILAR LOW TEMPERATURE LIQUIDS. O. R. Irrgang. Feb. 3, 1953. 31p. (MTA-32)
- NAA-SR-117 4412  
North American Aviation, Inc.  
AN APPARATUS FOR THE PRECISE MEASUREMENT OF MAGNETIC SUSCEPTIBILITIES BY THE FARADAY METHOD. J. J. Donoghue. Submitted Feb. 25, 1953. 46p. (NAA-SR-117)
- NYO-3839 4494  
Rochester Univ.  
RADIATIONS OF NEUTRON-DEFICIENT BARIUM AND CESIUM NUCLIDES. Richard W. Fink and Edwin O. Wieg. May 12, 1953. 5p. (NYO-3839)
- NYO-3892 4332  
Rutgers Univ.  
MOLECULAR DIMENSIONS OF THE GLASSY SODIUM POLYPHOSPHATES; AMPHIPATHIC INORGANIC COMPOUNDS. Ulrich P. Strauss. Mar. 1, 1953. 34p. (NYO-3892)
- NYO-3997 4495  
Princeton Univ.  
EXPERIMENTAL EVIDENCE FOR THE FERMI INTERACTION IN  $\beta$ -DECAY. R. Sherr and J. B. Gerhart. Apr. 8, 1953. 23p. (NYO-3997)
- NYO-4014 4327  
Atomic Energy Project, Western Reserve Univ.  
THE INFLUENCE OF X-IRRADIATION ON THE DISAPPEARANCE OF RADIOACTIVE TRACERS FROM CIRCULATING BLOOD. William J. MacIntyre, H. L. Friedell, and M. Berg. Issued May 25, 1953. 21p. (NYO-4014)



- NYO-4514 4329  
Johns Hopkins Univ.  
TRICKLING FILTER TREATMENT OF RADIOACTIVE CONTAMINATED LAUNDRY WASTES: FINAL REPORT. Earnest F. Gloyna and John C. Geyer. Dec. 15, 1952. 149p. (NYO-4514; JHUL-3)
- NYO-6217 4365  
Columbia Univ.  
NATURAL CONVECTION HEATING AND COOLING BY HORIZONTAL CYLINDERS: FINAL REPORT. [C. F. Bonilla and J. P. Collins.] [June 1, 1953.] 6p. (NYO-6217; CU-11-53)
- RME-3041 4376  
Pennsylvania State Coll. School of Mineral Industries  
AN INVESTIGATION OF THE MINERALOGY OF URANIUM-BEARING DEPOSITS IN THE BOULDER BATHOLITH, MONTANA: ANNUAL REPORT [FOR] JULY 1, 1952 TO MARCH 31, 1953. Harold D. Wright and Barrie H. Bieler. 31p. (RME-3041)
- RME-4007 4377  
Division of Raw Materials, AEC  
SELECTED BIBLIOGRAPHY ON URANIUM EXPLORATION AND THE GEOLOGY OF URANIUM DEPOSITS. Margaret Cooper. Issued Apr. 1953. 34p. (RME-4007)
- UCLA-257 4360  
Atomic Energy Project, Univ. of Calif., Los Angeles  
THE DECARBOXYLATION AND RECONSTITUTION OF LINOLEIC ACID. 2. IMPROVEMENTS IN THE PROCEDURE AND ITS APPLICATION TO THE PREPARATION OF 1-C<sup>14</sup>-LINOLEIC ACID. David R. Howton and Judd C. Nevenzel. Issued June 3, 1953. 21p. (UCLA-257)
- UCRL-2058 4439  
Radiation Lab., Univ. of Calif., Berkeley  
SUMMARY OF RESEARCH PROGRESS MEETING OF SEPTEMBER 25, 1952. Sergey Shewchuck. Dec. 18, 1952. 5p. (UCRL-2058)
- UCRL-2163 4480  
Radiation Lab., Univ. of Calif., Berkeley  
INTERACTIONS OF FAST ELECTRONS AND POSITRONS WITH MATTER (thesis). Charles E. Violet. Apr. 3, 1953. 76p. (UCRL-2163)
- UCRL-2196 4319  
Radiation Lab., Univ. of Calif., Berkeley  
THE METABOLISM OF F<sup>18</sup> IN NORMAL AND CHRONICALLY FLUOROSED RATS (thesis). Patricia C. Wallace. Apr. 30, 1953. 119p. (UCRL-2196)
- UCRL-2202 4333  
Radiation Lab., Univ. of Calif., Berkeley  
PROBLEMS IN THE AQUEOUS CHEMISTRY OF INDIUM (thesis). Loren George Hepler. May 1953. 60p. (UCRL-2202)
- UCRL-2214 4496  
Radiation Lab., Univ. of Calif., Berkeley  
PATTERNS IN ALPHA SPECTRA OF EVEN-EVEN NUCLEI. Frank Asaro and I. Perlman. May 13, 1953. 7p. (UCRL-2214)
- UR-217 4310  
Atomic Energy Project, Univ. of Rochester  
STUDIES ON FLASH BURNS: THE RELATION OF THE TIME AND INTENSITY OF APPLIED THERMAL ENERGY TO THE SEVERITY OF BURNS. J. B. Perkins, H. E. Pearse, and H. D. Kingsley. Dec. 1952. 58p. (UR-217)
- UR-229 4320  
Atomic Energy Project, Univ. of Rochester  
THE ACUTE INHALATION TOXICITY OF CARNOTITE ORE DUST; A THIRTY-DAY STUDY. H. B. Wilson, H. E. Stokinger, and G. E. Sylvester. Mar. 31, 1953. 22p. (UR-229)
- UR-246 4321  
Atomic Energy Project, Univ. of Rochester  
PHYSICO-CHEMICAL STUDIES OF BERYLLIUM COMPLEXES. 5. THE STATE OF BERYLLIUM IN BLOOD. Isaac Feldman, Jean R. Havill, and V. F. Neuman. Mar. 17, 1953. 24p. (UR-246)
- UR-247 4340  
Atomic Energy Project, Univ. of Rochester  
DETERMINATION OF CALCIUM IN BIOLOGICAL MATERIAL BY FLAME PHOTOMETRY. P. S. Chen, Jr. and T. Y. Toribara. Mar. 31, 1953. 18p. (UR-247)
- UR-255 4341  
Atomic Energy Project, Univ. of Rochester  
THE RADIUM CONTENT OF COMMON FOODS. Paul D. Shandley. Apr. 22, 1953. 28p. (UR-255)
- OTHER UNCLASSIFIED REPORTS OF  
SPECIAL INTEREST TO AEC LABORATORIES
- AERE-C/R-1154 4356  
Atomic Energy Research Establishment, Harwell, Berks (England)  
THE INFRA-RED SPECTRA AND MOLECULAR STRUCTURE OF SOME INORGANIC HEXAFLUORIDES. PART 4. ReF<sub>6</sub>. J. Gaunt and G. Naish. Mar. 31, 1953. 9p. (AERE-C/R-1154)
- AERE-M/R-1143 4379  
Atomic Energy Research Establishment, Harwell, Berks (England)  
THE HOT COMPACTING OF METAL POWDERS. J. Williams and K. H. Westmacott. Feb. 2, 1953. 38p. (AERE-M/R-1143)
- KZ-3423 4372  
[SAM Labs.]  
VACUUM TESTING HANDBOOK FOR COLUMBIA PROJECT, SECTION 106. C. B. Ellis. [1943] 38p. (KZ-3423)
- NACA-TN-2928 4380  
Langley Aeronautical Lab., NACA  
AXIAL-LOAD FATIGUE PROPERTIES OF 24S-T AND 75S-T ALUMINUM ALLOY AS DETERMINED IN SEVERAL LABORATORIES. H. J. Grover and W. S. Hyler, Battelle Memorial Inst. and Paul Kuhn and Charles B. Landers, Langley Aeronautical Lab., NACA and F. M. Howell, Aluminum Co. of America. May 1953. 63p. (NACA-TN-2928)
- NACA-TN-2935 4381  
National Bureau of Standards  
THE GALVANIC CORROSION THEORY FOR ADHERENCE OF PORCELAIN-ENAMEL GROUND COATS TO STEEL. Dwight G. Moore, J. W. Pitts, J. C. Richmond, and W. N. Harrison. June 1953. 19p. (NACA-TN-2935)
- NACA-TN-2956 4369  
Langley Aeronautical Lab., NACA  
CREEP-BUCKLING ANALYSIS OF RECTANGULAR-SECTION COLUMNS. Charles Libove. June 1953. 24p. (NACA-TN-2956)
- NBS-4C-102 4375  
National Bureau of Standards  
INVESTIGATION TO DEVELOP HEAT RESISTING COATINGS TO PROTECT METAL ALLOYS AGAINST CORROSION: QUARTERLY PROGRESS REPORT [FOR THE PERIOD ENDING MARCH 31, 1953]. Apr. 1, 1953. 14p. (NBS-4C-102; Quarterly Progress Report 2)
- NP-4571 4397  
Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
PRECISION SCATTERING AND OTHER RESEARCHES. Mar. 1953. 53p. (NP-4571; Technical Report 5)



- NP-4571(p.21-7) 4467  
Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
INTEGRAL EQUATION FOR STRIPPING, p.21-7 of  
PRECISION SCATTERING AND OTHER RESEARCHES.  
E. Gerjuoy. Mar. 1953. 7p. (NP-4571(p.21-7))
- NP-4571(p.28-53) 4468  
Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
THEORY OF (d,p) AND (d,n) REACTIONS, p.28-53 of  
PRECISION SCATTERING AND OTHER RESEARCHES. E.  
Gerjuoy. Mar. 1953. 26p. (NP-4571(p.28-53))
- NP-4573 4382  
Battelle Memorial Inst.  
A METALLURGICAL STUDY OF MOLYBDENUM; QUAR-  
TERLY STATUS REPORT COVERING THE PERIOD  
MARCH 1, 1952 TO MAY 31, 1952. June 1, 1952. 133p.  
(NP-4573; Quarterly Status Report 12)
- NP-4574 4398  
New York Univ.  
RESEARCH OF FLUORESCENCE AND CONDUCTIVITY  
PHENOMENA; QUARTERLY PROGRESS REPORT [FOR]  
AUGUST, SEPTEMBER, AND OCTOBER 1952. Hartmut  
Kallmann. Submitted Mar. 1953. 76p. (NP-4574;  
Quarterly Progress Report 7)
- NP-4587 4363  
California Research Corp.  
THE DEVELOPMENT OF A HIGH TEMPERATURE  
AIRCRAFT HYDRAULIC FLUID; ANNUAL REPORT [FOR  
PERIOD JANUARY 3, 1952 TO JANUARY 2, 1953]. Feb.  
1953. 83p. (NP-4587; Annual Report 3)
- NP-4589 4383  
Battelle Memorial Inst.  
PRODUCTION OF SOUND DUCTILE JOINTS IN MOLYBDE-  
NUM; PROGRESS REPORT [FOR] PERIOD MARCH 30,  
1953 TO APRIL 30, 1953. M. I. Jacobson, D. C. Martin,  
and C. B. Voldrich. Apr. 30, 1953. 23p. (NP-4589)
- NP-4590 4384  
Utah Univ.  
HETEROGENEOUS EQUILIBRIUM BETWEEN CARBON  
IN IRON AND IN IRON ALLOYS WITH CARBON MONOXIDE  
AND CARBON DIOXIDE AND WITH HYDROGEN AND  
WATER VAPOR BETWEEN 700°C AND 1100°C. H. Ed.  
Flanders, John R. Lewis, C. J. Christensen, Robert E.  
Brailsford, Robert Bates, and Surindar Singh. May 1953.  
68p. (NP-4590; Technical Report 1)
- NP-4594 4309  
Air Univ. School of Aviation Medicine  
BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING  
RADIATION: THE EFFECT OF X-RADIATION ON THE  
ISOLATED FROG HEART. Eugene B. Konecni and Herbert  
B. Gerstner. May 1953. 10p. (NP-4594; Report 3)
- NP-4606 4385  
Metals Corrosion Lab., Bureau of Mines  
CORROSION STUDIES ON TITANIUM AND ZIRCONIUM  
METALS: MONTHLY REPORT FOR APRIL 1953. L. B.  
Golden, W. L. Acherman, W. Mace, D. Schlain, R. E. Heise,  
Jr., and D. Steele. 11p. (NP-4606)
- NP-4607 4386  
Metals Corrosion Lab., Bureau of Mines  
CORROSION STUDIES ON TITANIUM AND ZIRCONIUM  
METALS: MONTHLY REPORT FOR MAY 1953. L. B.  
Golden, W. L. Acherman, W. Mace, D. Schlain, R. E.  
Heise, Jr., D. Steele, and C. Kenahan. 8p. (NP-4607)
- NP-4617 4420  
Department of Mines and Technical Surveys, Mines Branch,  
Ottawa (Canada)  
A RADIOMETRIC ASSAY UNIT FOR BAGGED RADIO-  
ACTIVE ORE. A. H. Bettens and G. G. Eichholz. May 4,  
1953. 14p. (NP-4617; TR-110/53)
- TEI-318 4339  
Geological Survey  
A QUANTITATIVE RADIOCHEMICAL METHOD FOR THE  
DETERMINATION OF THE MAJOR SOURCES OF NATURAL  
RADIOACTIVITY IN ORES AND MINERALS. J. N. Rosholt,  
Jr. Apr. 1953. 35p. (TEI-318)
- USNRDL-393 4322  
Naval Radiological Defense Lab.  
STUDIES ON THE TREATMENT OF INTERNAL RADIO-  
ACTIVE CONTAMINATION. 3. EFFECT OF CHEMICAL  
AGENTS ON THE SKELETAL CONTENT AND EXCRETION  
OF INJECTED STRONTIUM-89. S. H. Cohn and J. K. Gong.  
Feb. 25, 1953. 17p. (USNRDL-393)
- WADC-TR-52-202 4387  
Materials Lab., Wright Air Development Center  
A PRELIMINARY INVESTIGATION ON THE EFFECTS OF  
SURFACE TREATMENTS ON THE FATIGUE STRENGTH  
OF TITANIUM ALLOYS Ti-150A AND RC-130B. Heinrich  
K. Adenstedt, Frank E. Binns, and Robert J. Rooney. Feb.  
1953. 26p. (WADC-TR-52-202)
- WADC-TR-52-249 4388  
Battelle Memorial Inst.  
DEVELOPMENT OF TITANIUM-BASE ALLOYS: SUMMARY  
REPORT COVERING THE PERIOD MAY 19, 1951 TO MAY  
18, 1952. June 18, 1952. 244p. (WADC-TR-52-249)
- WADC-TR-52-313(pt.1) 4389  
Battelle Memorial Inst.  
BRAZING TITANIUM TO TITANIUM AND TO MILD AND  
STAINLESS STEELS. W. J. Lewis, P. S. Rieppel, and C. B.  
Voldrich. Nov. 1952. 38p. (WADC-TR-52-313(pt.1))
- WADC-TR-52-334 4390  
Battelle Memorial Inst.  
DEVELOPMENT OF TITANIUM-BASE ALLOYS: SUM-  
MARY REPORT COVERING THE PERIOD MAY 19, 1952  
TO DECEMBER 7, 1952. Dec. 31, 1952. 157p. (WADC-  
TR-52-334)
- WAL-401/25-1 4334  
Watertown Arsenal Lab.  
THERMODYNAMIC ASPECTS OF THE REDUCTION OF  
TITANIUM TETRACHLORIDE WITH HYDROGEN. (SECOND  
PARTIAL REPORT ON PRODUCTION OF TITANIUM IN  
AN ARC FURNACE.) T. A. Ferraro, Jr. and F. Marmo.  
May 26, 1952. 30p. (WAL-401/25-1; AD-4696)



## GENERAL

### ATOMIC BOMBS AND WARFARE

4301

EFFECT OF FALL-OUT FROM ATOMIC BLAST ON BACKGROUND COUNTING RATE. A. Fafarman and M. H. Shamos. *Nucleonics* 11, No. 6, 80-1(1953) June.

During the measurement of cosmic radiation on the Empire State Building, an opportunity was taken to measure the fall-out from the Nevada atomic tests, the background counting rate being augmented by the fall-out and by rainfall. (J.S.R.)

## BIOLOGY AND MEDICINE

4302

Los Alamos Scientific Lab.

ABSORPTION OF LIQUID HTO AND HTO VAPOR THROUGH THE SKIN OF MAN. Ernest A. Pinson, Ernest C. Anderson, and Virginia Lotz. June 1952. 17p. (AECU-2571; LADC-1326)

Data are presented on percutaneous absorption of HTO by the arm of a man from an atmosphere saturated with HTO vapor, and with the arm immersed in liquid HTO. Comparison with data on HTO absorption through the lung indicates that the tritium taken into the body through the total skin surface from an environment containing HTO or  $T_2O$ , when the possible but undetermined protective effect of clothing is ignored, would approximately equal that absorbed via the respiratory tract. (C.H.)

4303

Pennsylvania Univ. School of Medicine

THE MITOCHONDRIA OF BACTERIA. Stuart Mudd. [1953] 27p. (AECU-2578)

The properties of cytoplasmic granules in bacteria as determined by means of the electron microscope, phase microscope, cytochemistry, and enzymology are summarized, and these properties are compared with the properties ascribed to mitochondria in higher forms. The author defines the mitochondria of bacteria as cytoplasmic granules, dense by electron microscopic and phase microscopic examination, possessing limiting membranes, and possessing coordinated systems of oxidative-reductive enzymes, containing phospholipid and, at least in certain cases, metaphosphate. They range from prolate ellipsoids and spheroids, similar in dimensions to the smaller mitochondria of mammalian cells, to spheroids well below the limits of microscopic resolution. Functional differences detected among bacterial mitochondria are discussed. (C.H.)

4304

Brookhaven National Lab.

THE FORMATION OF TETANUS ANTITOXIN BY SPLEEN AND LYMPH NODE INTRAOCULAR TRANSPLANTS. William M. Hale and Richard D. Stoner. [1953] 23p. (BNL-1409)

Lymph node and spleen tissue from immunized donor mice will produce tetanus antitoxin when transplanted to the anterior chamber of the eye of  $\gamma$ -irradiated recipients. More antitoxin is formed by the transplants from immunized donors when the recipients are injected intravenously with fluid tetanus toxoid. (auth)

4305

Brookhaven National Lab.

A METHOD FOR ERADICATION OF THE MITE, *MYOCOPTES MUSCULINUS* FROM LABORATORY MICE. Richard D. Stoner and William M. Hale. [1953] 6p. (BNL-1414)

A method is described for eradication of the Listerphorid mite, *Myocoptes musculus*, from laboratory mice using the miticide di-(p-chlorophenyl) methylcarbinol (DMC). Additional control measures for maintenance of a mite-free mouse colony are suggested. (auth)

### RADIATION EFFECTS

4306

Mound Lab.

STUDIES ON CELL DIVISION. 1. ALPHA RADIATION AS A DIVISION INHIBITING AGENT. E. S. Spoerl and R. J. Balske. Apr. 28, 1953. Decl. June 1, 1953. 35p. (AECU-3528; MLM-820)

As a background for studies of biochemical cell changes, the effects of  $\alpha$  radiation upon the division and growth of *S. cerevisiae* and *E. coli* have been described and discussed. It was shown that division in *E. coli* was inhibited without affecting growth, but that an effect upon both division and growth occurred when yeast were irradiated. The inhibition of division was complete and occurred at low radiation doses. The inhibition of growth in yeast depended upon radiation dose, rate of culture growth, and the apparent existence of a component of growth either linked to division or sensitive to the radiation dose needed to stop division. The occurrence of cell killing by radiation was discussed, and survival data for irradiated yeast cultures were presented. The results of this work illustrate the response of microorganisms to culture-contained radioisotopes. Implications of the fact that inhibition of growth and inhibition of division are sometimes interrelated and sometimes independent of each other are discussed from the standpoint of their importance in studies of cell division. (auth)

4307

Brookhaven National Lab.

STUDIES WITH RADIOPHOSPHORUS IN *DROSOPHILA*. 2. THE EFFECT OF  $P^{32}$  TREATMENT UPON DEVELOPMENT. Robert C. King. [1953] 13p. (BNL-1406)

Exposure of developmental stages of *Drosophila melanogaster* to media of activities above  $5 \mu\text{g/g}$  results in the killing of embryos, larvae, and pupae, in the retardation of development, and in the production of sterile adults. Females are more resistant to  $P^{32}$  treatment than males. The external radiation from the medium is shown to be relatively unimportant in killing the insects. (auth)

4308

Los Alamos Scientific Lab.

THE RELATIVE BIOLOGICAL EFFECTIVENESS OF



TRITIUM IN DEPRESSING IRON UPTAKE IN RATS. John Furchner, John Storer, and Virginia Lotz. Mar. 1953. 19p. (LA-1544)

Rats were exposed to total-body  $\beta$  radiation by intravenous injections of tritium oxide. Concentrations of tritium oxide in the body water were maintained by appropriate concentrations of tritium in drinking water. On the second day of exposure  $\text{Fe}^{59}\text{Cl}_3$  was injected intravenously. Bone marrow damage from tritium  $\beta$  radiation was measured by comparing the  $\text{Fe}^{59}$  uptake of the red blood cells of the exposed animals with that of unirradiated controls. A parallel experiment was performed in which rats were exposed to the  $\gamma$  radiation of  $\text{Co}^{60}$  over the same time period and at essentially the same dose rates delivered by the tritium  $\beta$  radiation. The percentage of normal Fe uptake varied inversely with the log of the dose in both experiments. Comparison of the effects of the two radiations gave a relative biological effectiveness of 1.59 for the  $\beta$  radiation of tritium compared with the  $\gamma$  radiation of  $\text{Co}^{60}$ . (auth)

4309

Air Univ. School of Aviation Medicine  
BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION: THE EFFECT OF X-RADIATION ON THE ISOLATED FROG HEART. Eugene B. Konecni and Herbert B. Gerstner. May 1953. 10p. (NP-4594; Report 3)

The immediate effects of ionizing radiation on 150 isolated frog hearts were studied. The dose rate was 3000 r per min of x radiation. Without exception, the isolated hearts failed to produce perceivable ventricular contractions within an exposure time of 40 min, and the ventricle was dilated to an extreme degree. Three types of stroke-amplitude responses occurring under the beam prior to ventricular failure were observed. In most of the experiments a marked disturbance of cardiac rhythm occurred. The isolated heart appears to be suitable for screening protective agents to ionizing radiation. (auth)

4310

Atomic Energy Project, Univ. of Rochester  
STUDIES ON FLASH BURNS: THE RELATION OF THE TIME AND INTENSITY OF APPLIED THERMAL ENERGY TO THE SEVERITY OF BURNS. J. B. Perkins, H. E. Pearce, and H. D. Kingsley. Dec. 1952. 58p. (UR-217)

The physical, biological, histological, and statistical methods used to produce and to evaluate radiant-energy burns are discussed. The influence of variations in the time and intensity of applied radiant energy on severity were studied in a series of 1684 burns in the pig. In general, an inverse relation exists between the time and the intensity of applied radiant energy in the production of cutaneous burns, although exact reciprocity fails. With increased exposure time, an increased amount of energy is required to cause a similar degree of surface damage. This relation also exists for burns evaluated microscopically except for "deep dermal" burns where the reverse is true. Variations in the pathological picture are described and discussed. The demarcation between damaged and undamaged tissue is more abrupt with short than with long exposure times. A limited number of burns on human volunteers were studied. The amount of energy required to produce an erythematous burn in the pig is approximately equal to that causing a first-degree burn in man. At a higher critical energy level the same relation exists for patchy coagulation in the pig and a second-degree burn in man. A mathematical analysis based on semiinfinite opaque solid theory is appended. This offers possible explanations for the experimental results. (auth)

4311

THERAPEUTIC ACTION OF GLUTATHIONE AND MERCAPTOETHYLAMINE AGAINST A LETHAL DOSE OF X-RAYS. J. H. Maisin, G. Lambert, M. Mandart, and H. Maisin. *Nature* 171, 971(1953) May 30.

Experiments are reported which show that reduced glutathione and  $\beta$ -mercaptoethylamine have a therapeutic action when injected into rats exposed to a lethal total-body dose of x radiation if the liver area is shielded during the exposure. (C.H.)

4312

THE X-IRRADIATION OF MARINE GAMETES. A STUDY OF THE EFFECTS OF X-IRRADIATION AT DIFFERENT LEVELS ON THE GERM CELLS OF THE CLAM, SPISULA (FORMERLY MACTRA). Roberts Rugh. *Biol. Bull.* 104, 197-209(1953) Apr.

Experiments are reported in which the spermatozoa of the clam, Spisula, were found to be more radioresistant than the eggs, when measured by the ability to cleave and to develop into trochophores. The effects of various doses of x radiation on the development of the germ cells are summarized. Comparison is made with results in similar studies on sea urchins. No protection against radiation injury of gametes and early developing forms was afforded by cysteine hydrochloride or by  $\beta$ -mercaptoethylamine. (C.H.)

4313

HEPATIC GLYCOGEN IN ACUTE RADIATION DEATH. Barnet Levy and Roberts Rugh. *Proc. Soc. Exptl. Biol. Med.* 82, 223-5(1953) Feb.

A drastic depletion in liver glycogen, as determined both by histochemical and microchemical tests, was demonstrated in both warm-blooded animals and in cold-blooded amphibia following exposure to lethal doses of x radiation. The possibility of using liver response as a diagnostic aid in determining the extent of radiation damage is discussed briefly. (C.H.)

4314

EFFECTS OF FRACTIONATED DOSES OF X-RADIATION ON NORMAL AND TUMOR TISSUE. L. C. Fogg and R. F. Cowing. *Cancer Research* 13, 321-6(1953) Apr.-May.

Fractionated doses of 294 r produce a greater effect on spermatogonia and spermatocytes in partially shielded mice than does an equivalent acute dose. After irradiation has caused depopulation of the tubules of spermatogonia, subsequent recovery is from capsular cells, called pre-spermatogonia. The prespermatogonia are more resistant to radiation than are spermatogonia. Oocytes and spermatocytes are relatively comparable in their response to doses of irradiation. As compared to the testis, recovery following depopulation of germinal cells in the ovary is greatly delayed. The fractionated dose required to depopulate the testis or ovary of germinal cells is not sufficient to cause destruction of all tumor cells in the tumors studied. Apparently, induced resistance has not been achieved by repeated doses of irradiation under the conditions of procedure. (auth)

RADIATION HAZARDS AND PROTECTION

4315

[Sandia Corp.]  
MEASUREMENT OF SLOW NEUTRONS AND COEXISTING RADIATIONS. P. S. Harris. [1953] 20p. (AECU-2572; LADC-1438)

A direct and accurate measurement of slow neutrons for biological studies is complicated by the methods required for production of an adequate flux and the lack of methods



for determination of tissue doses. The indirect method of measuring thermal neutrons in terms of relative biological effect is more accurate at present. Often the different components of the radiation have been measured separately. Foil activation of In or Mn is a standard method of measuring slow neutrons. The fast neutrons are estimated by the determination of the Cd-In ratio. The  $\gamma$  flux is measured by the use of B and Li metal. The  $\gamma$  radiation can be reduced by 1-in. Bi shielding. A relative measurement of the radiation may be obtained by comparison of effects caused by a standard radiation and effects caused by slow neutrons. As the biological effect must be absolutely defined, lethality and lens opacity are adequate indices for the measurement of radiation. The equivalence of r, rem, and rep to standard x radiation can be assured by adequate control of the radiation. (J.S.R.)

4316

Brookhaven National Lab.

THE PROTECTIVE EFFECT OF INTRAOCULAR TRANSPLANTS UPON COBALT-60 GAMMA IRRADIATED MICE. Richard D. Stoner and William M. Hale. [1952] 20p.

(BNL-1401)

Lymph node and spleen intraocular transplants exhibit a higher percentage "take" in recipient mice given 600 rep sublethal  $\gamma$  irradiation than in nonirradiated controls. Lymph node transplants did not alter the mortality found with an LD<sub>50</sub> exposure to  $\gamma$  irradiation. Intraocular spleen transplants increased the survival of irradiated mice. "Immunization" of mice with lymph node and spleen homogenates decreased the percentage "take" of intraocular transplants. Irradiation of the "immunized" mice resulted in an increase in the per cent "take" of the transplants. Irradiation of donor mice immediately before and 48 hr before transplantation into irradiated mice destroyed the protective capacity of the splenic intraocular transplants. The combination of intraocular splenic transplantation with antibiotic therapy resulted in a slight additive increase in the survival of Co<sup>60</sup>  $\gamma$ -irradiated mice. (auth)

4317

THE TRUE BODY DOSIMETER PRINCIPLE. William A. Shurcliff. *Nucleonics* 11, No. 6, 76-80(1953) June.

The errors in dosimeter readings and their importance are discussed. Two methods, extrapolation and compensation, are discussed by which a dosimeter reading will closely approximate the total amount of radiation received by the wearer. (J.S.R.)

4318

CHEMICAL PROTECTION AGAINST X RAYS; THERAPEUTIC TESTS. A. Hervé and Z. M. Bacq. *J. radiol. et électrol.* 33, 651-5(1952). (In French)

A brief report is given of the authors' research on chemical protection against ionizing radiations. The therapeutic effects of amine derivatives and particularly of  $\beta$ -mercaptoethylamine are discussed. The results obtained with  $\beta$ -mercaptoethylamine injections in 30 cases of radiation sickness are tabulated. (J.S.R.)

## TOXICOLOGY STUDIES

4319

Radiation Lab., Univ. of Calif., Berkeley

THE METABOLISM OF F<sup>18</sup> IN NORMAL AND CHRONICALLY FLUOROSED RATS (thesis). Patricia C. Wallace. *Apr.* 30, 1953. 119p. (UCRL-2196)

Recent studies on the metabolism and toxicology of fluorides are reviewed. Studies are reported in which tracer and radioautographic techniques using F<sup>18</sup> were employed to study the metabolism of inorganic fluorides in rats. Data

are presented on absorption, tissue distribution, and excretion of F when administered orally and by intravenous injection to young adult females; virgin, pregnant, and lactating mature females; and chronically fluorosed animals. No significant impairment of thyroid function which could be attributed to chronic fluoride intoxication was observed when the thyroid uptake of I<sup>131</sup> and the red cell-to-plasma ratio of intravenously administered I<sup>131</sup> were used as indices of thyroid function. 133 references. (C.H.)

4320

Atomic Energy Project, Univ. of Rochester

THE ACUTE INHALATION TOXICITY OF CARNOTITE ORE DUST; A THIRTY-DAY STUDY. H. B. Wilson, H. E. Stokinger, and G. E. Sylvester. *Mar.* 31, 1953. 22p. (UR-229)

Rabbits, rats, and one goat were exposed to inhalation of a carnotite ore dust, from Durango Mill, assaying 20% U and 5% V. The chamber concentration of the dust was 84 mg/m<sup>3</sup>; mass median particle diameter, 1.4  $\mu$ ; duration of the experiment, 137 exposure hr during 32 calendar days. The percentage of U in the dusty atmosphere increased with decreasing particle size. Toxicity was evidenced in rabbits by high mortality, loss of weight, sharp increase of blood nonprotein N, incidence of urinary protein, and histologic evidence of renal tubular damage; in rats by weight loss, renal tubular damage, and gross lung damage; and in goats by renal tubular damage. U and V content of the rat lungs increased linearly with exposure hours, and deposits of these elements in terminally sacrificed rats were 370 and 146  $\mu$ g/g fresh tissue respectively. These amounts were 50 to 300 times as great as corresponding deposits in femur and kidney. Similar differences were noted in the tissues of the rabbits and the goat. The only haematologic finding of interest was basophilic stippling of the blood cells in two of the exposed rabbits. The results of this study are compared with those of an acute UO<sub>3</sub> experiment. The two sets of results were almost identical. (auth)

4321

Atomic Energy Project, Univ. of Rochester

PHYSICO-CHEMICAL STUDIES OF BERYLLIUM COMPLEXES. 5. THE STATE OF BERYLLIUM IN BLOOD. Isaac Feldman, Jean R. Havill, and W. F. Neuman. *Mar.* 17, 1953. 24p. (UR-246)

Dialysis studies were performed with plasma, sera, and various aqueous solutions to obtain information on the transport of Be in vivo. It was shown that most of the Be added to plasma or serum reacts with citrate and orthophosphate anions. At very low concentrations of Be (<  $\sim 10^{-7}$  M), both anions act as solubilizers. The phosphate complex has a very limited solubility, however, and at concentrations of Be greater than  $\sim 10^{-7}$  M this complex forms a nondiffusible colloid stabilized presumably by protective colloid action of the plasma proteins. Minor solubilizing influences exerted by other anions and the significance of these findings are briefly discussed. (auth)

4322

Naval Radiological Defense Lab.

STUDIES ON THE TREATMENT OF INTERNAL RADIOACTIVE CONTAMINATION. 3. EFFECT OF CHEMICAL AGENTS ON THE SKELETAL CONTENT AND EXCRETION OF INJECTED STRONTIUM-89. S. H. Cohn and J. K. Gong. *Feb.* 25, 1953. 17p. (USNRDL-393)

The administration of the salts of (ethylenediamine)tetraacetic acid (EDTA) under the most favorable conditions for its action had no effect on the skeletal distribution of injected carrier-free Sr<sup>89</sup>. Zr citrate administered prior to the injection of Sr<sup>89</sup> resulted in a level of Sr<sup>89</sup> in the skeleton



at 5 days 40% lower than that found in the controls. A corresponding increase in  $\text{Sr}^{89}$  excretion was also noted. Combined administration of EDTA with Zr citrate and with BAL are without effect on the skeletal distribution of injected  $\text{Sr}^{89}$ . Possible explanations for the effect of the various chemical agents employed are discussed. (auth)

4323

CUTANEOUS GRANULOMA CAUSED BY BERYLLIUM. Alejandro A. Cordero and Eduardo B. Molina. *Prensa med. argentina* 40, 468-73 (1953) Feb. 20. (In Spanish)

Distinct lesions on the skin and subcutaneous cellular tissues caused by Be are reported. Particular attention is given to the clinical and histopathological study of the granulomas caused by wounds cut with fragments of fluorescent lamps. A typical granuloma was shown spectrographically to contain Be. (tr-auth)

## TRACER APPLICATIONS

4324

Brookhaven National Lab.

STUDIES WITH RADIOPHOSPHORUS IN *DROSOPHILA*. 3. THE TURNOVER OF PHOSPHORUS IN ADULT *D. MELANOGASTER* AND *D. SIMULANS*. Robert C. King. [1953] 11p. (BNL-1405)

The turnover of P by adult males and females of *Drosophila melanogaster* and *D. simulans* was studied utilizing  $\text{P}^{32}$ . The half times of P turnover by adult male and female *D. melanogaster* and adult *D. simulans* males and females are  $3\frac{1}{3}$ , 2,  $3\frac{1}{2}$ , and 3 days, respectively. All 4 classes of flies lose P by two phase systems. The turnover of P by female *D. melanogaster* is faster than that of males because their fast phase has a shorter half time than that of males. Male *D. simulans* lose P more slowly than females because of the longer half time of the slow phase of males. (auth)

4325

Brookhaven National Lab.

INSULIN AND THE RELATION BETWEEN PHOSPHATE TRANSPORT AND GLUCOSE METABOLISM. Jacob Sacks and F. Marott Sinex. [1952] 14p. (BNL-1412)

The amount of  $\text{C}^{14}$ -glucose converted to  $\text{CO}_2$  and glycogen by rat diaphragm has been compared with the amount of  $\text{P}^{32}$ -phosphate incorporated into ATP, phosphocreatine, and hexosemonophosphate. Insulin was found to increase the transport of phosphate into diaphragm by 50%. The increases found were of the same order of magnitude for phosphocreatine P, the labile P of ATP, and hexosemonophosphate P. In confirmation of the findings of previous investigators, insulin was found to increase both the oxidation of glucose and the deposition of glycogen, without any effect on the O consumption of the tissue. On a molar basis, the increment caused by insulin in the transfer of the medium's  $\text{P}^{32}\text{O}_4$  to the  $\text{PO}_4$ , ATP, phosphocreatine, and hexosemonophosphate of diaphragm was about twice as great as the increment caused by insulin in the conversion of the medium's glucose to  $\text{CO}_2$  and diaphragm glycogen. The transport of phosphate across the cell membrane by esterification is estimated to require about 2% of the energy supplied by oxidative processes. (auth)

4326

Hanford Works

THE ABSORPTION AND TRANSLLOCATION BY PLANTS OF RADIOACTIVE ELEMENTS FROM "JANGLE" SOIL. A. A. Selders, J. H. Rediske, and R. F. Palmer. Feb. 16, 1953. 12p. (HW-27620)

A study was made of the uptake of radioactive elements from Jangle test-site soil by four species of plants. The addition of nutrients to this soil increased the uptake of

these radioactive elements, but in no case was the uptake over 2.8% of the activity in the soil on a concentration basis. (auth)

4327

Atomic Energy Project, Western Reserve Univ.

THE INFLUENCE OF X-IRRADIATION ON THE DISAPPEARANCE OF RADIOACTIVE TRACERS FROM CIRCULATING BLOOD. William J. MacIntyre, H. L. Friedell, and M. Berg. Issued May 25, 1953. 21p. (NYO-4014)

The influence of x irradiation on the disappearance of tagged serum albumin ( $\text{I}^{131}$ ) and tagged red cells ( $\text{P}^{32}$ ) from the circulating blood of dogs has been investigated for the period immediately following x-ray exposure. This has been accomplished by establishing a complete external flow circuit through cannulation of the femoral artery and femoral vein of dogs and utilizing a continuous recording method of measuring the concentration of radioactive substances in the blood. With this system the concentration of the radioactive materials in the blood was continuously measured for a 1 to 2 hr period following injection in order to establish normal disappearance. Without disruption of the system, the dogs were exposed to approximately 1000 r of x irradiation and the measurements resumed. No change in the disappearance rate of the serum albumin or red cells could be detected for a period of 6 hr following irradiation. In addition, attempts were made to determine if any change in the appearance of radioactive material in the peripheral vascular circulation of irradiated animals could be detected. Although this work is preliminary, the appearance curves achieved equilibrium so rapidly that no differences in immediate effects could be observed. (auth)

4328

JET INJECTION OF RADIOISOTOPES; A CLINICAL STUDY COMPARING NEEDLE AND JET INJECTION OF  $\text{I}^{131}$ ,  $\text{K}^{42}$ , AND  $\text{Na}^{24}$ . Franz K. Bauer, Benedict Cassen, Elsie Youtcheff, and Lucille Shoop. *Am. J. Med. Sci.* 225, 374-8 (1953) April.

$\text{I}^{131}$  in amounts of 0.5  $\mu\text{c}$  was injected by hypodermic needle and by jet injection into the thighs of healthy control subjects and patients with a variety of clinical conditions. The disappearance rate of the injected isotope as measured with the wide angle scintillation counter was much more uniform after jet injection than after needle injection.  $\text{K}^{42}$  and  $\text{Na}^{24}$  in identical amounts were injected by jet into some of the same control subjects and patients, and it was found that the disappearance times were similar to those obtained with  $\text{I}^{131}$ . (auth)

## WASTE DISPOSAL

4329

Johns Hopkins Univ.

TRICKLING FILTER TREATMENT OF RADIOACTIVE CONTAMINATED LAUNDRY WASTES: FINAL REPORT. Earnest F. Gloyna and John C. Geyer. Dec. 15, 1952. 149p. (NYO-4514; JHUL-3)

The biological oxidation of complex synthetic laundry wastes and the concentration of radioactive isotopes in biological slimes and sludges were studied. Rotary slime tubes, a trickling filter, and agitation flasks were used to study the effects of laundering aids on organisms. The primary biological treatment device developed to treat radioactive laundry waste was a system of rotary tubes in which slimes were grown. These rotary tubes received wastes at the rate of one drop/sec which gave a loading believed to be equivalent to that on a trickling filter 6-ft deep, when operating at a loading rate of 8 million



gal/acre/day and receiving a waste similar to that applied to rotary tubes. The major laundry-waste contaminants investigated were citrate, Versene, Igepal, and 7 radioactive isotopes. Citrate was readily utilized by bacteria and yeast, while Versene, in concentrations over 125 ppm, displayed serious slime-destroying properties. Igepal, in concentrations less than 125 ppm, exhibited little effect upon slimes. Organisms, in an agitated batch process where the pH became alkaline because of metabolic processes, attained maximum removals of 99% for  $\text{Sr}^{89}$ , 95% for  $\text{P}^{32}$ , 85% for  $\text{Ce}^{144}$ , and lesser amounts for  $\text{Ru}^{106}$ ,  $\text{I}^{131}$  and  $\text{Cs}^{134}$ . Rotary-tube slimes, supplied with various laundry wastes at a pH of 7.0, detained 45%  $\text{Ce}^{144}$ , 20%  $\text{P}^{32}$ , and lesser amounts of the other isotopes. Only  $\text{P}^{32}$  was released from the cell structure after the cells lost their viability. The primary factors which controlled the removal of radioactivity by microorganisms were pH, viability of organisms, type of isotope, toxicity of the waste, and the ratio of stable to radioactive isotopes. (auth)

## CHEMISTRY

4330

Radiation Lab., Univ. of Calif., Berkeley  
CHEMISTRY DIVISION QUARTERLY REPORT [FOR]  
SEPTEMBER, OCTOBER, [AND] NOVEMBER 1952. Dec.  
31, 1952. Decl. with deletions May 12, 1953. 66p. (AECD-  
3524; UCRL-2069)

Work reported on nuclear chemistry includes radioactive decay of  $\text{At}^{210}$ ,  $\text{At}^{211}$ , and  $\text{Po}^{211}$ ; nuclear properties of Bk and Cf isotopes; chemistry of Ce and Tb fluorides; isotope shift in the Pu spectra; nuclear-emulsion studies of  $\alpha$ -conversion electron coincidences in  $\text{Cf}^{248}$  and  $\text{Pu}^{234}$ ; half-life and  $\alpha$ -particle energy of  $\text{Ra}^{213}$ ;  $\alpha$  branching of  $\text{AcK}$  ( $\text{Fr}^{223}$ ) and the natural occurrence of At;  $\beta$  spectrum of  $\text{Fr}^{223}$ ; nucleon momentum distributions from high-energy (d,p) excitation functions; report on the radiochemical separation of Bi from Pb, Po, and Ra; extraction behavior of trivalent lanthanides and actinides elements into TBP from  $\text{HCl}$  and  $\text{HNO}_3$ ; and saturation backscattering correction for windowless proportional counter with  $2\pi$  geometry.

Work on bioorganic chemistry includes synthesis of glycine- $2\text{-C}^{14}$ , aspartic acid- $3\text{-C}^{14}$ , and high specific activity D,L-leucine- $3\text{-C}^{14}$ ; studies in morphine metabolism; effect of heparin on the rate of metabolism of fatty acids and other compounds;  $\Delta^7$ -cholesterol content of serum cholesterol; a possible primary quantum conversion act of photosynthesis; short-time photosynthesis experiments (sugar degradation); and mathematical models of biological systems. Work on basic chemistry, including metal chelates, covers thermodynamics of In; equilibrium values for the ferric fluoride complex ions; potential of  $\text{RuO}_4^-$ - $\text{RuO}_4$  couple; and thermodynamics of thiosulfate. Chemical engineering work covers preparation of Ti metal. (J.S.R.)

4331

California Research and Development Co.  
CONCERNING THE CORRELATION OF SOLID METAL AND  
NON-ELECTROLYTE SOLUBILITIES. P. L. Auer. Apr.  
14, 1953. 12p. (MTA-29)

The validity of using log mole fraction vs. reciprocal of absolute temperature or log of absolute temperature plots as tools for correlating the solubility of pure solid metals and nonelectrolytes is examined rigorously through the use of thermodynamic formulations. (auth)

4332

Rutgers Univ.

MOLECULAR DIMENSIONS OF THE GLASSY SODIUM  
POLYPHOSPHATES; AMPHIPATHIC INORGANIC COM-  
POUNDS. Ulrich P. Strauss. Mar. 1, 1953. 34p. (NYO-  
3892)

Eight samples of Na polyphosphate, covering a molecular weight range from 7000 to 20,000, were prepared by condensation polymerization of primary Na phosphate at temperatures ranging from 700 to 1000°C. Molecular weights were determined by light scattering in NaBr solutions. Viscosities were determined using both a 0.035N NaBr solution and water as solvents. In water, the results indicate rod-like structure of the polyelectrolyte molecules at infinite dilution. The end-to-end distances at infinite dilution, calculated from the intrinsic viscosity values, agreed well with the contour lengths calculated from the molecular weights, assuming complete absence of chain branching. All these measurements were obtained with solutions which had aged for at least 12 hr after dissolution. In the first 12 hr, the viscosity of the solutions decreased somewhat. This effect was ascribed to a small amount of chain branching in the glassy polymer. The branch points are unstable in water which causes an initial decrease of the molecular weight upon dissolution. (auth)

4333

Radiation Lab., Univ. of Calif., Berkeley  
PROBLEMS IN THE AQUEOUS CHEMISTRY OF INDIUM  
(thesis). Loren George Hepler. May 1953. 60p. (UCRL-  
2202)

Quantitative information concerning the equilibria between the various oxidation states of In in aqueous solution is presented, and the thermodynamic properties of some inorganic complex ions of In are given. Several recalculations of the experimental data of earlier workers have been made. (L.T.W.)

4334

Watertown Arsenal Lab.

THERMODYNAMIC ASPECTS OF THE REDUCTION OF  
TITANIUM TETRACHLORIDE WITH HYDROGEN. (SECOND  
PARTIAL REPORT ON PRODUCTION OF TITANIUM IN  
AN ARC FURNACE.) T. A. Ferraro, Jr. and F. Marmo.  
May 26, 1952. 30p. (WAL-401/25-1; AD-4696)

On the basis of available thermodynamic data, the feasibility of H reduction of  $\text{TiCl}_4$  in an arc furnace as a means of producing Ti metal was determined. Data on pertinent thermodynamic properties were compiled and reaction-free energies calculated for the partial and complete H reductions of the tetra-, tri-, di-, and monochloride of Ti through the temperature range 298 to 2000°K. Other reactions were also considered, and some equilibrium constants determined. Results indicate that complete reduction of  $\text{TiCl}_4$  with H is not likely to prove feasible as a means of producing Ti. (auth)

4335

HEAT CAPACITIES AT LOW TEMPERATURES AND EN-  
TROPIES AT 298.16°K OF HAFNIUM DIOXIDE AND  
HAFNIUM TETRACHLORIDE. S. S. Todd. *J. Am. Chem.*  
*Soc.* 75, 3035-6(1953) June 20.

Low-temperature heat capacity data and entropy values at 298.16°K for  $\text{HfO}_2$  and  $\text{HfCl}_4$  are reported. Experimental heat capacity values are tabulated. (J.E.D.)

4336

INVESTIGATION OF THE THERMAL DISSOCIATION, RE-  
ASSOCIATION, AND SYNTHESIS OF ZIRCON. C. E. Curtis  
and H. G. Sowman. *J. Am. Ceram. Soc.* 36, 190-8(1953)  
June 1.



The amount of dissociation present in zircon after 2-hr heating periods at temperatures between 2800 and 3600°F was determined by x-ray analysis of quenched specimens. The course of dissociation was followed in the same manner during 8- to 10-hr heating periods at temperatures of 2800, 3000, and 3200°F, respectively. Data are included that pertain to the synthesis of zircon from its constituent oxides at temperatures from 2100 to 2800°F. The results indicate that zircon is the stable phase up to about 2800°F; above that temperature it becomes unstable, the degree of instability increasing with temperature, especially above 3200°F. On the basis of the results obtained from this investigation, a revision of the present phase diagram of the system zirconia-silica is proposed. (auth)

4337

HIGH-TEMPERATURE HEAT CONTENTS OF TANTALUM AND NIOBIUM OXIDES. Raymond L. Orr. *J. Am. Chem. Soc.* 75, 2808-9(1953) June 20.

High-temperature heat-content measurements of Ta oxide ( $Ta_2O_5$ ) and Nb oxide ( $Nb_2O_5$ ) were conducted from 298° to temperatures slightly above 1800°K. A table of values of heat-content and entropy increments above 298.16°K and equations representing the heat-content results are included. (auth)

## ANALYTICAL PROCEDURES

4338

Los Alamos Scientific Lab.  
A CONTINUOUS TITRATION METHOD FOR CHOLINESTERASE DETERMINATIONS. Jean Captain Sabine. [1953] 12p. (AECU-2575; LADC-1416)

The design and operation of a continuous titration method for cholinesterase determinations is described in detail. The acetic acid liberated by hydrolysis of acetylcholine is continuously neutralized with dilute NaOH delivered from an uncalibrated Lucite capillary. The calibrated parts of the burette consist of a depth gage which drives the plunger of a tuberculin syringe. A pH meter is used with glass and calomel electrodes separated by a salt bridge. The method is suitable for determinations over a wide range of substrate concentrations, can be operated at any desired pH level, and requires only very light buffering. Rates of hydrolysis in the order of  $5 \times 10^{-7}$  moles/min can be measured with a standard error of  $\pm 1.2\%$ . (auth)

4339

Geological Survey  
A QUANTITATIVE RADIOCHEMICAL METHOD FOR THE DETERMINATION OF THE MAJOR SOURCES OF NATURAL RADIOACTIVITY IN ORES AND MINERALS. J. N. Rosholt, Jr. Apr. 1953. 35p. (TEI-318)

The determination of  $Th^{232}$ ,  $Rn^{222}$ , and  $Pb^{210}$  by isolation and subsequent activity analysis of some of their short-lived daughter products is described. The sulfides of Bi and Po are precipitated out of solutions of Th or U ores, and the  $\alpha$ -particle activity of  $Po^{214}$ ,  $Po^{212}$ , and  $Po^{210}$  is determined by scintillation-counting techniques.  $Po^{214}$  activity is used to determine  $Rn^{222}$ ,  $Po^{212}$  activity for  $Th^{232}$ , and  $Po^{210}$  for  $Pb^{210}$ . (auth)

4340

Atomic Energy Project, Univ. of Rochester  
DETERMINATION OF CALCIUM IN BIOLOGICAL MATERIAL BY FLAME PHOTOMETRY. P. S. Chen, Jr. and T. Y. Toribara. Mar. 31, 1953. 18p. (UR-247)

Calcium determinations in biological material by flame photometry at 820 m $\mu$  are convenient, rapid, and reliable. Phosphate suppresses the Ca emission, and protein partially prevents the action of phosphate. Studies to

determine when correction must be made for phosphate inhibition are reported. Procedures are given for determination of Ca in blood serum, serum ultrafiltrate, and urine. (auth)

4341

Atomic Energy Project, Univ. of Rochester  
THE RADIUM CONTENT OF COMMON FOODS. Paul D. Shandley. Apr. 22, 1953. 28p. (UR-255)

The Ra content of a number of common foods (i.e., powdered milk, fish, beans, peas, barley, and beef) was measured. With the exception of beef which contained no measurable amounts of Ra, the foods tested fell in the range from 0.74 to  $6.5 \times 10^{-15}$  g Ra per g starting material. A detailed description is given for a method of deemanation using a fritted disk to break up an air stream into small bubbles which sweep a column containing the Ra solution. Control experiments and recoveries are reported. (auth)

4342

WIF OXYGEN METER. Translated from Summary of Patents of Wiener Isolierrohr-, Batterie- und Metallwarenfabrik, G.m.b.H. by J. Hensoldt. 6p. (NP-2417)

4343

APPLICATION OF THE RADIOCHEMICAL METHOD TO THE DETERMINATION OF COPPER IN CELLULOSE ESTERS. J. Pouradier, A. M. Venet, and H. Chateau. *Chim. anal.* 35, 125-8(1953) June. (In French)

The method of activation analysis is described, as applied to the determination of Cu in cellulose acetate films. (J.S.R.)

## CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4344

Iowa State Univ.  
STRUCTURES AND PROPERTIES OF INTERMETALLIC COMPOUNDS; PROGRESS REPORT FOR THE PERIOD DECEMBER 1, 1952 TO MAY 31, 1953. Norman Charles Baenziger, J. W. Nielsen, and E. J. Duwell. June 1, 1953. 11p. (COO-126)

The crystal structures of NaHg and  $Na_3Hg_2$  were determined from Weissenberg and precession-camera data from single crystals. Diffraction data from a compound, tentatively designated as  $Na_3Hg_2$  were obtained. A method of analysis was devised which made it possible to determine the extent of the formation of an  $NH_4$ -Hg phase. (For preceding period see COO-123.) (J.E.D.)

## DEUTERIUM AND DEUTERIUM COMPOUNDS

4345

THE THERMAL TRANS-CIS ISOMERIZATION OF DIDEUTEROETHYLENE. B. S. Rabinovitch, John E. Douglas, and F. S. Looney. *J. Chem. Phys.* 20, 1807-8(1952) Nov.

The thermal isomerization of trans-ethylene- $d_2$  in quartz vessels over the pressure range 9 to 310 mm and in the temperature interval 450 to 550°C has been studied. The values of the kinetic constants and the negligible rate of isomerization due to quantum mechanical tunneling indicates the energy at the top of the singlet barrier. An estimation of the Z' state ( $\phi = \pi/2$ ) is made. Some C-C bond dissociation energies are given. (J.S.R.)

4346

ROTATIONAL ISOMERISM AND THE VIBRATIONAL SPECTRUM OF SYM-DIDEUTERODIBROMOETHANE. H. J. Bernstein, A. D. E. Pullin, B. S. Rabinovitch, and N. R. Larson. *J. Chem. Phys.* 20, 1227-31(1952) Aug.

Trans-ethylene- $d_2$  was brominated by two methods, which involved different stereochemical paths, to give



95% *meso*-BrDHC-CHDBr as one product and a mixture of *meso*- and *racemic*-BrDHC-CHDBr as the other. Liquid phase Raman spectra and liquid and solid phase infrared spectra of these materials have been obtained and a tentative assignment of the vibrational frequencies of BrDHC-CHDBr to the *trans* and *skew* configurations of the *meso* and *racemic* compounds has been made. (auth)

4347

OPTICAL DISPERSION OF PERDEUTEROBENZENE AND PERDEUTEROCYCLOHEXANE. Raymond T. Davis, Jr. and Robert W. Schiessler. *J. Am. Chem. Soc.* **75**, 2763-4 (1953) June 5.

Indexes of refraction of  $C_6H_6$ ,  $C_6D_6$ ,  $C_6H_{12}$ , and  $C_6D_{12}$ , determined at 5892.6, 5460.7, and 4358.3 Å, and the dispersion constants calculated from these indexes are recorded. (G.Y.)

4348

MECHANISMS OF ELIMINATION REACTIONS. X. DEUTERIUM EXCHANGE IN BASE-PROMOTED DEHYDROCHLORINATION OF  $\beta$ -BENZENE HEXACHLORIDE. Stanley J. Cristol and Delbert D. Fix. *J. Am. Chem. Soc.* **75**, 2647-8(1953) June 5.

$\beta$ -Benzene hexachloride was treated with Na ethoxide in deuterated ethanol under conditions under which one-half of the material would be dehydrochlorinated. The remaining reactant was isolated and was found to contain a small amount of deuterated  $\beta$ -benzene hexachloride. This result has been interpreted as a demonstration of the existence of a carbanion intermediate in this elimination reaction. (auth)

#### FLUORINE AND FLUORINE COMPOUNDS

4349

FLUORINATED ESTERS. III. DIESTERS OF CARBOXYLIC ACIDS WITH FLUORINE-CONTAINING ALCOHOLS AND GLYCOLS. Robert Filler, Jack V. Fenner, Charles S. Stokes, Joseph F. O'Brien, and Murray Hauptschein. *J. Am. Chem. Soc.* **75**, 2693-5(1953) June 5.

The preparation of a series of new esters and diesters of carboxylic acids with 1, 1-dihydroperfluoro alcohols, a fluorinated secondary alcohol, and an  $\alpha$ ,  $\alpha$ ,  $\omega$ ,  $\omega$ -tetrahydroperfluoro diol, is described. Physical and chemical properties of these compounds and of several intermediates are presented. (auth)

4350

THE HEAT AND ENTROPY OF IONIZATION OF HYDROFLUORIC ACID. THE ENTROPY OF BIFLUORIDE ION. Loren George Hepler, William L. Jolly, and Wendell M. Latimer. *J. Am. Chem. Soc.* **75**, 2809-10(1953) June 20.

The heats of solution of NaF in water and in aqueous perchloric acid have been measured. These values are used to calculate the heat of ionization of HF. By combining this heat with the free energy of ionization, the entropy of ionization is calculated.  $\Delta H^0 = -3180$  cal/mole and  $\Delta S^0 = -25.2$  e.u. This value is used in calculating the entropy of bifluoride ion which is found to be 26 e.u. (auth)

4351

FLUORIDE MODEL SYSTEMS: III. THE SYSTEM  $NaF-BeF_2$  AND THE POLYMORPHISM OF  $Na_2BeF_4$  AND  $BeF_2$ . Della M. Roy, Rustum Roy, and E. F. Osborn. *J. Am. Ceram. Soc.* **36**, 185-90(1953) June 1.

A revised equilibrium diagram is presented for the system  $NaF-BeF_2$ , a weakened model of the system  $CaO-SiO_2$ . The compound  $Na_2BeF_4$  has four structural modifications corresponding to the  $\gamma$ ,  $\beta$ ,  $\alpha'$ , and  $\alpha$  forms of  $Ca_2SiO_4$ . Inversion temperatures were found to be as follows:  $\alpha \rightleftharpoons \alpha' = 320^\circ C$ ,  $\gamma \rightarrow \alpha' = 225^\circ C$ ,  $\alpha' \rightleftharpoons \beta$  (metastable)  $= 115^\circ C$ . The quartz form of  $BeF_2$  was found to have a high-low inversion

at  $220^\circ C$ . The high-quartz form exists in equilibrium with liquid in binary fluoride systems up to the melting temperature of  $BeF_2$ , as closely as can be determined. The cristobalite form appears to have only a metastable existence, and a tridymite form has not been found. The compound  $Na-BeF_3$  has a structure similar to  $\beta-CaSiO_3$  below  $343^\circ C$ , with a different structure (not that of  $\alpha-CaSiO_3$ ) above this temperature. (auth)

4352

THE EFFECTS OF STRUCTURE ON THE VISCOSITIES OF PERFLUOROALKYL ETHERS AND AMINES. T. J. Brice and R. I. Coon. *J. Am. Chem. Soc.* **75**, 2921-5(1953) June 20.

The viscosities of a number of fluorocarbons, cyclic and straight chain fluorocarbon ethers, and perfluoroalkyl tertiary amines have been measured over a range of temperatures. The O- and N-containing compounds have lower viscosities than fluorocarbons of the same type (cyclic or straight chain) and the same number of carbon atoms. Thermodynamic quantities related to viscous flow were calculated. Possible reasons for the viscosity effects observed are discussed. (auth)

#### RADIATION CHEMISTRY

4353

FORMATION OF LABILE PHOSPHATE ESTERS BY IRRADIATION OF NUCLEIC ACIDS WITH X-RAYS IN AQUEOUS SYSTEMS. George Scholes and Joseph Weiss. *Nature* **171**, 920-1(1953) May 23.

Blank and x-irradiated nucleate solutions were hydrolyzed by dilute acid, and the amount of liberated inorganic phosphate was determined. With doses of the order of  $9 \times 10^4$  r, in the presence of O, the additional amounts of inorganic phosphate liberated from irradiated ribonucleic acid and desoxyribonucleic acid solutions are ~15 times the amounts of free phosphate formed during the irradiation. A discussion is presented of labile ester formation arising from oxidation of the sugar part of nucleic acids. (L.T.W.)

#### RARE EARTHS AND RARE-EARTH COMPOUNDS

4354

Ames Lab.

THE KINETICS OF THE CERIUM(IV)-CHLORIDE REACTION: THE CERIUM(IV) THALLOUS REACTION IN THE PRESENCE OF CHLORIDE. Frederick R. Duke and Curtis E. Borchers. Apr. 17, 1953. 12p. (ISC-334)

A kinetic study of the Ce(IV)-chloride reaction is made difficult at low chloride concentrations by the formation of higher oxidation states of Cl. Tl(I) added to reaction mixtures maintains a constant  $Cl^-$  concentration and prevents the formation of mixtures of oxidation products of  $Cl^-$ . The rate of the reaction is independent of the Tl(I) concentration and dependent on the  $Cl^-$  and  $H^+$  concentrations. (J.S.R.)

#### SEPARATION PROCEDURES

4355

PREPARATION OF  $As^{76}$  BY THE SZILARD EFFECT BEGINNING WITH CACODYLIC ACID. H. Laurent and P. Simonnin. *J. phys. radium* **14**, 294-8(1953) May. (In French)

A perfected method for the preparation of  $As^{76}$  of great specific activity is described. Cacodylic acid is irradiated with thermal neutrons and the As, extracted by the Szilard effect, is carried down by a  $Fe(OH)_3$  precipitate. After dissolving in HCl,  $Fe^{+3}$  is absorbed on a column filled with Dowex 50, and  $As^{76}$  is recovered as the ion  $AsO_4$ . (tr-auth)



## SPECTROSCOPY

4356

Atomic Energy Research Establishment, Harwell, Berks (England)  
**THE INFRA-RED SPECTRA AND MOLECULAR STRUCTURE OF SOME INORGANIC HEXAFLUORIDES. PART 4.  $\text{ReF}_6$ .** J. Gaunt and G. Naish. Mar. 31, 1953. 9p. (AERE-C/R-1154)

The infra-red and Raman spectra of  $\text{ReF}_6$  have been investigated. Three lines have been observed in the Raman effect which are assigned as fundamentals. The infra-red spectrum exhibits one intense absorption at  $716\text{ cm}^{-1}$ , which is also assumed to be a fundamental. The remainder of the infra-red spectrum has been successfully assigned along the lines indicated in previous reports on the assumption of octahedral symmetry. (See NSA 6-155 and 7-1401.) The thermodynamic properties have been calculated. (auth)

4357

Ames Lab.  
**THE INFRARED SPECTRA OF AROMATIC COMPOUNDS. 1. EVIDENCE INDICATING INTRAMOLECULAR HYDROGEN BONDING BETWEEN SUBSTITUENT GROUPS AND RING HYDROGENS.** M. Margoshes and V. A. Fassel. Apr. 15, 1953. 25p. (ISC-259(rev.))

The infrared absorption spectra of some aromatic compounds have been studied between  $625$  and  $900\text{ cm}^{-1}$ , where these compounds have C-H bending vibrations characteristic of the number and position of substituents. The band structure in this region was found, in many cases, to be considerably different from what is to be expected for the particular arrangement of substituents, especially for nitro compounds and carboxylic acids, esters, and salts. The main differences in the spectra are the presence of an additional strong absorption band in this wavelength region for certain types and arrangements of substituents and a consistent shift of the normal C-H bending vibrations to higher frequencies. The shifts of the C-H bending vibrations can be most readily explained as being due to an intramolecular C-H...O bond. Interatomic distances from x-ray-diffraction data and the variations in position of the absorption band with variations of the structure of the compounds are given as evidence for the presence of the hydrogen bond. (auth)

4358

Ames Lab.  
**A NEW APPROACH TO DIRECT READING SPECTRO-CHEMICAL ANALYSIS.** Richard K. Brehm and Velmer A. Fassel. May 6, 1953. 16p. (ISC-343)

In general, direct-reading control and research spectrometers now in common use employ a separate exit slit and multiplier phototube assembly for each spectral line measured. This, and associated techniques, impose several limitations such as the problem of positioning many exit slits, reflecting mirrors, and phototubes in a limited space, accurate temperature control of the spectrograph, etc. These limitations are circumvented by a system in which the spectra are rapidly scanned past a single exit slit-phototube assembly and the individual voltage pulses arising from the spectral lines electronically isolated. The operation of the spectrometer and associated equipment is discussed and a circuit schematic is presented. (L.M.T.)

4359

**AN INTERPRETATION OF THE VISIBLE AND NEAR-INFRARED SPECTRA OF  $\text{NpO}_2^+$  AND  $\text{PuO}_2^{++}$  IONS.** D. M. Gruen. J. Chem. Phys. 20, 1818-19(1952) Nov.

The spectra of  $\text{NpO}_2^+$  and  $\text{PuO}_2^{++}$  are interpreted on the assumption that the various bands arise from electronic

transitions between the term of the  $5f^2$  configuration. The classification of the levels in the LS and jj coupling schemes and the observed and calculated levels in LS and jj coupling for spin-orbit coupling of  $1100\text{ cm}^{-1}$  are tabulated. (J.S.R.)

## SYNTHESES

4360

Atomic Energy Project, Univ. of Calif., Los Angeles  
**THE DECARBOXYLATION AND RECONSTITUTION OF LINOLEIC ACID. 2. IMPROVEMENTS IN THE PROCEDURE AND ITS APPLICATION TO THE PREPARATION OF 1- $\text{C}^{14}$ -LINOLEIC ACID.** David R. Howton and Judd C. Nevenzel. Issued June 3, 1953. 21p. (UCLA-257)

A major improvement in the procedure for the decarboxylation and reconstitution of linoleic acid has been realized in the elution-chromatographic separation of the products of the Borodin degradation of Ag tetrabromostearate. In this way 96 to 99% of the starting material can be accounted for as the desired pentabromoheptadecane (70 to 71%), as esters (6 to 7%), and as regenerated tetrabromostearic acid (20 to 21%). Syntheses of 1- $\text{C}^{14}$ -linoleic acid and of methyl 1- $\text{C}^{14}$ -linoleate are described. (auth)

4361

**$\text{C}^{14}$ -LABELED COLCHICINE DERIVATIVES.** Robert F. Raffauf, Ann L. Farren, and Glenn E. Ulliyot. J. Am. Chem. Soc. 75, 2576-8(1953) June 5.

Six derivatives of colchicine, each labeled with  $\text{C}^{14}$  in a known position of the molecule, have been prepared. As an adjunct to the preparations involving labeled diazomethane, a method was developed for the quantitative estimation of this reagent in solutions containing it based upon the well-known ferric reaction of colchicine. (auth)

## ENGINEERING

4362

Livermore Research Lab., Calif. Research and Development Co.

**DESIGN OF PIPING SYSTEMS AND CONTROLS FOR LIQUID NITROGEN AND SIMILAR LOW TEMPERATURE LIQUIDS.** O. R. Irrgang. Feb. 3, 1953. 31p. (MTA-32)

Although this paper is mainly concerned with the problems of design for a liquid N system, it is apparent that the basic principles will apply to similar systems for other very low-temperature liquefied gases, and these principles can be briefly summarized as follows: Slope all piping upward in the direction of flow, wherever possible, to take advantage of the principle of the "air lift;" Avoid peaks or high pockets that may become gas traps; Study system designs carefully to reduce all possible heat leaks to a minimum; Use the best materials for very low-temperature service insulation with the lowest possible thermal conductivity, and metals which retain high strength and have low coefficients of thermal conductivity at very low temperatures; Use only specially constructed valves with Teflon-to-metal seats and positive stem seals to avoid leakage and waste; Valves must also have extended bonnets and stems of stainless steel to bring the stem seals and handles outside of the pipe insulation; Make instrumentation as simple as is practical utilizing the principle of the manometer for activation of level controllers and level indicators. (auth)



4363

California Research Corp.

THE DEVELOPMENT OF A HIGH TEMPERATURE AIRCRAFT HYDRAULIC FLUID; ANNUAL REPORT [FOR PERIOD JANUARY 3, 1952 TO JANUARY 2, 1953]. Feb. 1953. 83p. (NP-4587; Annual Report 3)

Progress for the year 1952 in the development of a high-temperature aircraft hydraulic fluid for operation from  $-65$  to  $400^{\circ}\text{F}$  is described. Compounds synthesized for investigation as base materials included silicates, trisiloxanes, silicon-phosphorus compounds, phosphonates, and miscellaneous compounds. Diethyl and methylphenyl silicones as well as polymethacrylates were investigated as viscosity-index improvers for silicate base fluids. Additives were evaluated for effects on high-temperature stability, hydrolytic stability, and antiwear properties. Four-ball wear tests and 3000 psi Vickers and New York Airbrake piston pump tests were conducted on several experimental fluids to determine lubricating properties. (auth)

## HEAT TRANSFER AND FLUID FLOW

4364

Carbide and Carbon Chemicals Co. (K-25)

THE ROLE PLAYED BY EDDY DIFFUSION IN TURBULENT FLOW: LITERATURE SURVEY. R. C. Bacon. Issued Sept. 28, 1951. Decl. with deletions June 1, 1953. 45p. (AEC-3527; K-816)

A compilation of 84 references with abstracts and 77 title listings, relative to the role played by eddy diffusion in turbulent flow, is presented. A brief introduction presents the author's interpretation of the role of eddy diffusion in turbulent flow. (C.H.)

4365

Columbia Univ.

NATURAL CONVECTION HEATING AND COOLING BY HORIZONTAL CYLINDERS: FINAL REPORT. [C. F. Bonilla and J. P. Collins.] [June 1, 1953.] 6p. (NYO-6217; CU-11-53)

Heat-transfer coefficients for natural convection at horizontal cylinders were measured in the heating and cooling of water, mercury, and 40% and 60% aqueous sucrose solutions. Two procedures were followed: an unsteady-state procedure in which no heat source or sink was in contact with the test fluid other than the cylinder at which measurements were being taken, the bulk fluid temperature being allowed to rise or fall without interference; and a steady-state procedure in which the bulk temperature was maintained constant at any location by the use of a heat source or sink to supply or remove the heat, respectively, for the test cylinder. Unsteady-state data were in marked disagreement with theoretically derived relationships and previously published correlations. This probably resulted from a vertical temperature gradient with a resultant density stratification that inhibited fluid motion. Although investigation showed that the relative positions of the walls, the test cylinder, and the opposing heat source or sink had some effect on the measured coefficient, the steady-state results were in excellent agreement with previous work. No significant difference between heating and cooling could be found for steady-state results, but direction of heat flow had considerable influence on the unsteady-state correlations. (auth)

4366

HEAT TRANSFER FROM CONDENSING STREAM TO TUBE WALL DURING IMPACT OF THE STEAM. A. P. Salikov. *Izvest. VTI* 21, No. 9, 17-20(1952) Sept. (In Russian)

Jets of steam from perforated tubes impinging on parallel

water-filled pipes of brass, Cu, or steel. Heat transfer during the process was investigated. 9 figures. (G.Y.)

4367

PHYSICAL PROPERTIES OF HIGH-TEMPERATURE LIQUID HEAT CONDUCTORS. N. B. Vargaftik, B. E. Neimark, and O. N. Oleshchuk. *Izvest. VTI* 21, No. 9, 1-7(1952) Sept. (In Russian)

A detailed experimental study of the thermal and flow properties of the fused salt system 53%  $\text{KNO}_3$ -7%  $\text{NaNO}_3$ -40%  $\text{NaNO}_2$  at temperatures up to  $550^{\circ}\text{C}$  is reported. (G.Y.)

4368

HEAT TRANSFER AND RESISTANCE OF TUBES IN TRANSVERSE GAS FLOW AT LOW  $\text{Re}$  VALUES. Ya. L. Polynovskii. *Izvest. VTI* 21, No. 9, 12-17(1952) Sept. (In Russian)

## MATERIALS TESTING

4369

Langley Aeronautical Lab., NACA

CREEP-BUCKLING ANALYSIS OF RECTANGULAR-SECTION COLUMNS. Charles Libove. June 1953. 24p. (NACA-TN-2956)

A previous analysis of the creep behavior of a slightly curved pin-ended H-section column under constant load is extended to the slightly curved solid rectangular-section column. The analysis leads to a differential equation for the plastic strains at the midheight cross section. The form of the equation indicates the significant parameters which may be useful in plotting test data on the creep life of columns. These are a lifetime parameter  $t'_{cr}$ , an initial-straightness parameter  $S$  or  $S'$ , and the ratio of the average applied stress to the Euler stress  $\bar{\sigma}/\sigma_E$ . A numerical method of solving the differential equation, suitable for use with a high-speed digital computer, is described, and typical computed results are given. The existence of a finite lifetime, although not evident from the differential equation, is argued intuitively and confirmed by the numerical computations. (auth)

4370

REPEATED-BENDING MACHINE. Edwin Erlinger (to the Carl Schenck Iron Foundry and Machine Shop, Darmstadt, Ltd., of Darmstadt) German Patent 677436, June 1, 1939. 3p. (AEC-TR-2054)

## VACUUM SYSTEMS

4371

Brookhaven National Lab.

A COMBINATION HIGH VACUUM AND PRESSURE VALVE. Edward G. Reilly. [1953] 3p. (BNL-1410)

A combination high-vacuum and pressure valve was developed to meet the need for a counter-gas filling and shut-off valve that would not only permit an adequate flow of gas when evacuating the counter but would function under pressure conditions ranging from high vacuum up to 400 psi. (J.E.D.)

4372

[SAM Labs.]

VACUUM TESTING HANDBOOK FOR COLUMBIA PROJECT, SECTION 106. C. B. Ellis. [1943] 38p. (KZ-3423)

A procedure is described for testing vacuum systems for leaks. A portable mass spectrometer is used to detect He introduced into the system after first creating a vacuum. The testing equipment is described in detail and illustrated, and operating instructions are included. (C.H.)



## WASTE DISPOSAL

4373

Du Pont de Nemours, E. I., and Co., Engineering Dept. SAVANNAH RIVER PLANT STACK GAS DISPERSION AND MICROCLIMATE SURVEY. L. L. Falk, C. B. Cave, W. R. Chalker, J. A. Greene, and C. W. Thorngate. Jan. 1953. 155p. (DP-19)

Atmospheric-diffusion and microclimate studies at Savannah River are reported. A new simple method was developed enabling operating personnel to establish the downwind concentration and dispersion pattern of materials released from stacks. A statistical study of atmospheric temperature inversions was made because of their influence on atmospheric diffusion. The microclimate of the plant site is compared with Augusta. (auth)

4374

Idaho Operations Office, AEC  
RADIOACTIVE WASTE REMOVAL IN A TRICKLING FILTER SEWAGE PLANT. A. L. Biladeau. May 1953. 12p. (IDO-24010)

A modified conventional trickling-filter sewage system designed to handle simultaneously both domestic sewage and radioactive laundry wastes is described. In this system radioactive materials in suspension or solution are concentrated by bacteria, thus reducing the activity in the final effluent. Provision is made for measuring the flows and testing the activities at various stages in the system. Controls enable flow rates and other quantities to be varied to insure optimum operating conditions. (C.H.)

## MINERALOGY, METALLURGY, AND CERAMICS

## CERAMICS AND REFRACTORIES

4375

National Bureau of Standards  
INVESTIGATION TO DEVELOP HEAT RESISTING COATINGS TO PROTECT METAL ALLOYS AGAINST CORROSION: QUARTERLY PROGRESS REPORT [FOR THE PERIOD ENDING MARCH 31, 1953]. Apr. 1, 1953. 14p. (NBS-4C-102; Quarterly Progress Report 2)

During the quarter, a total of 36 additional coatings were designed, compounded, and tested. The ceramic-metal coatings did not bond to the base metal during firing, and flaked off before testing. Two unfritted coatings showed good adherence to the base metal after firing, but did not afford appreciable protection against oxidation in the extended heating test. Several of the frit-refractory coatings adhered well to Inconel and types 321, 309, and 310 stainless steel. None of the coatings gave complete protection to type 321 stainless steel at 1900°F. Two coatings appeared to protect Inconel at this temperature, and several coatings when applied to types 309 and 310 stainless steel were in good condition after the extended heating test. (auth)

## GEOLOGY AND MINERALOGY

4376

Pennsylvania State Coll. School of Mineral Industries  
AN INVESTIGATION OF THE MINERALOGY OF URANIUM-BEARING DEPOSITS IN THE BOULDER BATHOLITH, MONTANA: ANNUAL REPORT [FOR] JULY 1, 1952 TO MARCH 31, 1953. Harold D. Wright and Barrie H. Bieler. 31p. (RME-3041)

Mineralogical problems concerning U-bearing deposits in the Boulder Batholith, Montana, have been divided for convenience into three groups: vein and ore mineralogy, wall rock mineralogy, and weathering mineralogy (with emphasis on secondary U deposition). The problems under laboratory investigation and the methods of study involve phases of each of the three major groups. Most of the studies thus far have been devoted to the "siliceous reef" deposits. Data on vein and ore mineralogy of the W. Wilson and Free Enterprise "siliceous reefs" were obtained from microscopic studies of thin sections and polished surfaces, and from x-ray and electron microscope studies. Systematic study of the "base metal" deposits has been limited to the Lone Eagle due to inaccessibility or inadequate exposure of most workings. The Lone Eagle deposit has a simple base-metal sulfide association of pyrite, sphalerite, and galena in a microcrystalline quartz gangue. Uraninite and argentite have been tentatively identified. The wall-rock alteration is closely similar to that in the W. Wilson and Free Enterprise. Similarity of the microcrystalline quartz gangue and the wall-rock alteration suggest a close relation between the "siliceous reef" and "base metal" deposits. In dump specimens from the Gray Eagle deposit, uraninite has been identified in a simple base-metal sulfide association with finely crystallized quartz. Information has been obtained concerning the U mineral and its relation to associated minerals occurring in scattered "hot spots" in workings of the Anaconda Copper Mining Company in Butte. (auth)

4377

Division of Raw Materials, AEC  
SELECTED BIBLIOGRAPHY ON URANIUM EXPLORATION AND THE GEOLOGY OF URANIUM DEPOSITS. Margaret Cooper. Issued Apr. 1953. 34p. (RME-4007)

This bibliography consists of 104 selected references dealing with the various phases of U exploration and the geology of the different types of U deposits found in the United States and throughout the world. The papers are grouped under the following headings: Exploration for U (with subdivisions on prospectors' guides, geobotanical prospecting, geochemical prospecting, and both airborne and ground geophysical prospecting); Geochemistry, Geophysics, and Analytical Determinations; Geology of Uranium Deposits; Mineralogy of Uranium and Thorium Minerals; and General Bibliographies. (auth)

## METALS AND METALLURGY

4378

Los Alamos Scientific Lab.  
THE PREPARATION OF SAMARIUM METAL. E. I. Onstott. [1953] 3p. (AECU-2573; LADC-1441)

A method is described for the preparation of Sm metal having a purity greater than 99.5%. The metal is produced by a reaction of Ba with anhydrous SmBr<sub>3</sub> in a Ta crucible in A at a temperature of 1650 to 1700°C for a period of 20 min. During this heating period the Sm metal is collected in the bottom of the crucible and the excess Ba distilled out. The yield of metal is about 10 g for a 50-g batch of bromide. (C.H.)

4379

Atomic Energy Research Establishment, Harwell, Berks (England)  
THE HOT COMPACTING OF METAL POWDERS. J. Williams and K. H. Westmacott. Feb. 2, 1953. 38p. (AERE-M/R-1143)

The hot-compacting behavior of Cu, Fe, Al, Th, Zr, Ag, Mg, and Be has been investigated dilatometrically, and the results have been found to be most readily interpreted as a two-stage process of densification. During the first stage



the powder mass exhibits non-Newtonian flow characteristics, an approximately second-power relation connecting the rate of strain and stress. A phenomenological explanation for the existence of this relation is given, and the nature of the yield-point term necessitated by the explanation is examined. Dislocation movement is considered to be responsible for material flow during this first stage, and possible implications of the scale of the process and crystallographic restrictions are discussed. It is during the second-stage of densification that diffusion is likely to be the controlling process, but the position is not as clear as for the preceding stage. Possible effects to be expected consequent upon the proposed modes of densification are outlined, and certain points of technological importance are given. (auth)

4380

Langley Aeronautical Lab., NACA  
AXIAL-LOAD FATIGUE PROPERTIES OF 24S-T AND 75S-T ALUMINUM ALLOY AS DETERMINED IN SEVERAL LABORATORIES. H. J. Grover and W. S. Hyler, Battelle Memorial Inst. and Paul Kuhn and Charles B. Landers, Langley Aeronautical Lab., NACA and F. M. Howell, Aluminum Co. of America. May 1953. 63p. (NACA-TN-2928)

In the initial phase of an NACA program on fatigue research, axial-load tests on 24S-T3 and 75S-T6 Al-alloy sheet have been made at the Battelle Memorial Institute and at the Langley Aeronautical Laboratory of the NACA. The test specimens were polished and unnotched. The manufacturer of the material, the Aluminum Company of America, has made axial-load tests on 24S-T4 and 75S-T6 rod material. The test techniques used at the three laboratories are described in detail; the test results are compared with each other and with results obtained on unpolished sheet by the National Bureau of Standards. (auth)

4381

National Bureau of Standards  
THE GALVANIC CORROSION THEORY FOR ADHERENCE OF PORCELAIN-ENAMEL GROUND COATS TO STEEL. Dwight G. Moore, J. W. Pitts, J. C. Richmond, and W. N. Harrison. June 1953. 19p. (NACA-TN-2935)

The galvanic corrosion theory of adherence between ground-coat enamels and steel was investigated. The theory, which is based on mechanical anchoring of the enamel into pits formed by galvanic attack of the enamel on the steel, was first examined from the standpoint of data on adherence obtained in earlier studies. Also, several experiments were performed which demonstrated that galvanic corrosion could occur during the short firing times encountered in enamel processing. However, inconsistencies were observed in the data which indicated that the mechanism of galvanic attack followed by mechanical anchoring was not the only important factor affecting bond strength. (auth)

4382

Battelle Memorial Inst.  
A METALLURGICAL STUDY OF MOLYBDENUM; QUARTERLY STATUS REPORT COVERING THE PERIOD MARCH 1, 1952 TO MAY 31, 1952. June 1, 1952. 133p. (NP-4573; Quarterly Status Report 12)

The work described includes preparation of Mo by the vacuum-fission method, development of oxidation-resistant Mo alloys, high-temperature property measurement, ductility of Mo as a function of gaseous elements in solid solutions, ductility and anelasticity of Mo, ductility of Mo weldments, metallographic and fractographic studies of Mo, vacuum-fission analytical method, and a study of the principles of O impregnation of Mo. (J.S.R.)

4383

Battelle Memorial Inst.  
PRODUCTION OF SOUND DUCTILE JOINTS IN MOLYBDE-

NUM; PROGRESS REPORT [FOR] PERIOD MARCH 30, 1953 TO APRIL 30, 1953. M. I. Jacobson, D. C. Martin, and C. B. Voldrich. Apr. 30, 1953. 23p. (NP-4589)

W-arc welds were made in Climax arc-cast and in Fansteel and Westinghouse powder-metallurgy Mo sheet with unalloyed Mo filler metal. The welds in Climax sheet were sound, while those in Fansteel and Westinghouse sheets contained considerable porosity. Th, Ti, Zr, and Al were tried as deoxidizers for welds in powder-metallurgy sheet. It was found that around 20% Th or Zr was required to produce a weld relatively free of porosity. The weld metal obtained from deposits made with Mo-10% Th filler metal was ductile at room temperature. However, Mo-Th alloys are hot short, as evidenced by weld-metal cracking. Although ductile weld metal could be produced, no weldments with transverse ductility could be made. This was due to recrystallization and consequent embrittlement that the heat of welding caused in the base metal adjacent to the weld. (For preceding period see NP-4532.) (auth)

4384

Utah Univ.  
HETEROGENEOUS EQUILIBRIUM BETWEEN CARBON IN IRON AND IN IRON ALLOYS WITH CARBON MONOXIDE AND CARBON DIOXIDE AND WITH HYDROGEN AND WATER VAPOR BETWEEN 700°C AND 1100°C. H. Ed. Flanders, John R. Lewis, C. J. Christensen, Robert E. Brailsford, Robert Bates, and Surindar Singh. May 1953. 68p. (NP-4590; Technical Report 1)

A study of the phase diagram of Fe-C solid solution and liquid solution is reported. The Fe samples are treated with an equilibrium mixture of H and CH<sub>4</sub>. The reaction between Fe and CH<sub>4</sub> is quite sluggish and incomplete carburization occurs. An approximate mechanism for the reaction is given. (J.S.R.)

4385

Metals Corrosion Lab., Bureau of Mines  
CORROSION STUDIES ON TITANIUM AND ZIRCONIUM METALS: MONTHLY REPORT FOR APRIL 1953. L. B. Golden, W. L. Acherman, W. Mace, D. Schlain, R. E. Heise, Jr., and D. Steele. 11p. (NP-4606)

Evaluation tests on the susceptibility of Ti, Zr, Ti-Zr alloys, and stainless steels to stress corrosion cracking in red fuming HNO<sub>3</sub> are reported. The results of bending samples beyond the elastic limit into a "U" shape, held under stress in a special holder, and completely immersed in the acid at room temperature are given. Electrode potential measurements and galvanic couple tests indicate that Ti (arc-melted) is electronegative with respect to Al alloy (61ST6) in He-aerated 0.1N H<sub>2</sub>SO<sub>4</sub> solution. (For preceding report in series see NP-4547.) (J.E.D.)

4386

Metals Corrosion Lab., Bureau of Mines  
CORROSION STUDIES ON TITANIUM AND ZIRCONIUM METALS: MONTHLY REPORT FOR MAY 1953. L. B. Golden, W. L. Acherman, W. Mace, D. Schlain, R. E. Heise, Jr., D. Steele, and C. Kenahan. 8p. (NP-4607)

Evaluation tests on the susceptibility of Ti, Zr, Ti-Zr alloys, and stainless steels to stress corrosion cracking in red fuming HNO<sub>3</sub> were completed. An induction-melted Ti-Zr alloy containing 10.3% Ti showed no evidence of embrittlement after thirty days. Arc-melted high-purity Zr showed evidence of some slight embrittlement, while three induction-melted Fe-Zr alloys containing, respectively, 1.2, 2.6, and 4.0% Fe were appreciably weakened by exposure to the acid. An induction-melted Sn-Zr alloy containing 2.2% Sn was slightly embrittled. Type 316 stainless steel showed a definite loss of mechanical strength, but Carpenter No. 20 stainless steel was unaffected. A series of



tests was made on arc-melted Ti exposed to highly corrosive acid solutions to which small amounts of potential corrosion inhibitors had been added. Zirconium was found to be electropositive with respect to commercially pure Al in highly corrosive solutions and was resistant to corrosion in these solutions. Coupling with Al did not affect this resistance. (J.E.D.)

4387

Materials Lab., Wright Air Development Center  
A PRELIMINARY INVESTIGATION ON THE EFFECTS OF SURFACE TREATMENTS ON THE FATIGUE STRENGTH OF TITANIUM ALLOYS Ti-150A AND RC-130B. Heinrich K. Adenstedt, Frank E. Binns, and Robert J. Rooney. Feb. 1953. 26p. (WADC-TR-52-202)

The evaluation of the effects of various treatments on the fatigue properties of Ti bar stock alloys Ti-150A (2.6% Cr, 1.3% Fe, and 0.2% O) and RC-130B (4% Mn and 4% Al) was made. The various treatments of Ti-150A and their corresponding fatigue endurance limits are as follows: (1) machined and polished—68,000 psi; (2) ground—63,000 to 70,000 psi; (3) 10% permanently stretched and ground—54,000 psi (wide scatter of data); (4) ground and scaled—56,000 psi; (5) machined notched—40,000 psi; and (6) ground and notched—21,000 psi. The fatigue strength varied from about 35 to 45% of the tensile ultimate strength for the different treatments, except for the notched condition as would be expected. RC-130B gave endurance limits of about 67,000 psi (approximately 45% of tensile ultimate strength) for the ground, unnotched condition, and about 24,000 psi for the ground-notched material. The wide range of values for the ground Ti-150B alloy and for the 10% stretched and ground Ti-150A alloy may have been due to various degrees of surface cold work, and surface discontinuities, caused by grinding and cold work. In addition, radiography identified W inclusions which were probably a contributing factor. In general, the surface treatment has a marked effect upon the fatigue strength of Ti and its alloys. For the conditions tested, a machined and polished surface produced the optimum fatigue properties. (auth)

4388

Battelle Memorial Inst.  
DEVELOPMENT OF TITANIUM-BASE ALLOYS: SUMMARY REPORT COVERING THE PERIOD MAY 19, 1951 TO MAY 18, 1952. June 18, 1952. 244p. (WADC-TR-52-249)

The experimental work consisted of melting and testing exploratory alloys. Past work indicated that the addition of the  $\beta$ -stabilizing elements such as Cr, Fe, Mn, Mo, and V, offered the best possibility in the development of Ti alloys. This observation was verified when ternary and complex alloys containing these elements were tested and found to possess desirable properties. A number of exploratory alloys were heat-treated and tested to determine the general effects of different thermal cycles on tensile properties. The effects of quenching media and low temperature aging were also investigated. As a result of the studies on the binary-type alloys such as Ti-Cr and Ti-Mn containing from 5 to 8% of the alloying element, the hypothesis was proposed that the  $\beta$  phase is susceptible to a hardening phenomenon involving a submicroscopic precipitation of the  $\alpha$  phase. Recrystallization, isothermal-transformation studies, and welding experiments were conducted using binary Ti-Cr alloys. Ductile welds in the "as-welded" condition were obtained in these high strength alloys. (WADC abstr.)

4389

Battelle Memorial Inst.  
BRAZING TITANIUM TO TITANIUM AND TO MILD AND STAINLESS STEELS. W. J. Lewis, P. S. Rieppel, and C. B. Voldrich. Nov. 1952. 38p. (WADC-TR-52-313(pt.1))

Procedures and alloys suitable for brazing Ti were investigated. Commercial brazing alloys were evaluated by making brazed joints of Ti in a furnace containing an atmosphere of high-purity Ar. The most satisfactory alloys in this type of brazing were Ag and Ag-base alloys. Joints with shear strengths averaging 15,000 psi were obtained by furnace brazing. Brazed joints of Ti were also made with the oxy-acetylene torch and a commercial brazing flux. The best alloy found in torch brazing was a 45% Ag, 15% Cu, 16% Zn, 24% Cd-alloy, which produced shear strengths averaging 13,000 psi. The strengths of brazed joints in Ti were somewhat lower than that of similar brazed joints of the same alloys in C steels. The lower strengths are believed to be associated with the intermetallic compounds which formed at the boundaries between the brazing alloy and Ti. Also, broad zones of diffusion were present at some of the boundaries. Some of the intermetallic compounds appeared to be brittle. Ag and the 85% Ag-15% Mn alloy were the only brazing alloys that produced joints exhibiting some ductility. (auth)

4390

Battelle Memorial Inst.  
DEVELOPMENT OF TITANIUM-BASE ALLOYS: SUMMARY REPORT COVERING THE PERIOD MAY 19, 1952 TO DECEMBER 7, 1952. Dec. 31, 1952. 157p. (WADC-TR-52-334)

Suitable heat treatments for the high-strength Ti alloys have been developed. By varying the heat treatment it has been possible to obtain tensile strengths of 150,000 psi with an elongation of 25% in one inch. Solution treating at higher temperatures generally increases the strength but with a corresponding loss in ductility. It now seems commercially probable to solution-treat, machine, and subsequently age, thus producing alloys with a high strength level. A new phase, called  $\omega$ , has been discovered by x-ray-diffraction studies. This  $\omega$  phase seems to be responsible for the loss in ductility, or embrittlement, which accompanies an increase in tensile strength upon heat treatment. Results indicate that the  $\omega$  phase vanishes after a certain time at elevated temperatures; therefore, the  $\omega$  phase may be a transition product from  $\beta$  to  $\alpha$ . The  $\omega$  phase is pseudocubic in nature and localized increased concentrations of alloying elements indicate that the  $\omega$  phase is lower in alloy content than the original  $\alpha$ . The  $\omega$  phase definitely appears to be connected with the high hardness characteristics of  $\beta$ -stabilized alloys. A significant development has been the production of ductile arc welds in  $\alpha$ - $\beta$  alloys; varying degrees of ductility have been obtained in  $\alpha$ - $\beta$  alloys by annealing or tempering after welding. A program has been initiated whereby industrial concerns will evaluate the newly developed alloys of Ti for large-scale usage. (auth)

4391

PORE FORMATION AND ITS EFFECT ON THE RATE OF EVAPORATION OF THE VOLATILE COMPONENTS FROM A SOLID ALLOY. F. A. Santalov. Translated by G. Belkov from Zhur. Tekh. Fiz. 20, 564-70(1950). 17p. (AEC-TR-1488)

4392

INFLUENCE OF PLASTIC DEFORMATION ON THE SUBSEQUENT CRUMBLING IN Al-Si AND Al-Mg-Si ALLOYS. N. N. Byinov and V. P. Savinykh. Doklady Akad. Nauk S.S.S.R. 88, 257-9(1953) Jan. 11. (In Russian)

The effect of plastic deformation on the subsequent crumbling of Al-Si (1.2% Si) and Al-Mg-Si (1.4% Mg, Si) alloys was investigated by means of an electron microscope. The samples were annealed, tempered, and subjected to compression. In the Al-Si alloy plastic deformation accelerated crumbling. The principle effect in the Al-



Mg-Si alloy was an increase in the number of distinct particles. (J.S.R.)

4393

ON THE WELDING OF TITANIUM ALLOYS. C. B. Voldrich. Welding J. (N.Y.) 32, 497-515(1953) June.

The present status of knowledge on the welding of Ti and Ti alloys is summarized through discussions of the following: (1) various welding processes now in use; (2) alloy effects, including solid-strengthening, transformation effects, and compound formation; (3) influence of N, C, O, and H on weld properties, and (4) welding tests of Ti alloyed with both  $\beta$ - and  $\alpha$ -stabilizing elements. (L.M.T.)

4394

EFFECT OF ATMOSPHERIC CONTAMINANTS ON ARC WELDS IN TITANIUM. J. C. Barrett, I. R. Lane, Jr., and R. W. Huber. Welding J. (N.Y.) 32, 283s-291s(1953) June.

Preliminary results of tests to determine the effects and permissible limits of atmospheric contaminants on arc welds in Ti are presented. Welds in pure He atmospheres were found to have properties comparable to those of the pure metal in tension and bending tests. The relative humidity of the He atmosphere should be <5%. He atmospheres containing N<sub>2</sub> and O<sub>2</sub> should contain <1% of these elements; severe embrittlement occurs when these gases (singly) comprise 10% of the gaseous mixture. H<sub>2</sub> is not as detrimental as O<sub>2</sub> or N<sub>2</sub> to tensile and bend properties of welds; an increase of H<sub>2</sub> to 10% resulted in no drastic lowering of these properties. It is suggested that protection from a contaminating atmosphere within the chamber can be achieved by passing dry He through the welding torch. (L.M.T.)

4395

TRANSIENT CREEP IN PURE METALS. O. H. Wyatt. Proc. Phys. Soc. (London) B66, 459-80(1953) June 1.

A constant-stress testing machine of small inertia and with continuous strain recording has been built. The loading was by air contained in metallic bellows whose wall stiffness was compensated by a "negative spring." The initial strain rate was standardized. Polycrystalline Cu and Al have been investigated between -196 and 140°C. At low temperatures, the creep curves fitted  $\epsilon = \alpha \log t + c_1$ ; at higher temperatures they fitted  $\epsilon = \beta t^{1/2} + c_2$ . These are called  $\alpha$  and  $\beta$  creep respectively. In an intermediate temperature range the curves fitted  $\epsilon = \alpha \log t + \beta t^{1/2} + c_3$ . The results have been confirmed for Cd and commercially pure Al, and also for Al with only a few grains per specimen. In a series of increment tests the stress was altered by small amounts at various times during a creep curve; in the  $\alpha$  range only, the curves after the increments were similar to segments of the parent curve. The effect of testing a specimen at increasing stresses and different temperatures was also investigated; in the  $\alpha$  range only, an equation of state, that is  $F(\alpha, \epsilon, d\epsilon/dt, T) = 0$ , was obeyed. A theory of  $\alpha$  creep is developed: an exhaustion theory is applied to a metal whose strain hardening is defined by a reference curve. The rise of activation stress during a creep curve and the slope of the reference curve are deduced from the increment and creep tests; and the slope agrees numerically with the stress-strain curve at -196°C. From an equation of state, values of the mean activation energy at a strain rate of  $10^{-4}$  cm/cm/sec, and the frequency of thermal fluctuations are obtained. (auth)

## PHYSICS

4396

Knolls Atomic Power Lab.

THE USE OF SELF-EQUILIBRATING EIGENFUNCTIONS

IN SOLUTION OF SOME BEAM PROBLEMS. G. Horvay and J. S. Born. [1953] 18p. (AECU-2576)

Stress-concentration factors are derived for the simplest type of self-equilibrating loads on a beam. (auth)

4397

Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
PRECISION SCATTERING AND OTHER RESEARCHES.  
Mar. 1953. 53p. (NP-4571; Technical Report 5)

This report is a compilation of reprints and articles of certain researches carried on at the Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh. Abstracts of six of the articles which were printed in Phys. Rev. and Rev. Sci. Instr. have already appeared in Nuclear Science Abstracts (see NSA 6-1919; 6-4934; 6-4970; 7-360; 7-412; and 7-1245). Separate abstracts have been prepared for two other articles, Integral Equation for Stripping and Theory of (d,p) and (d,n) Reactions, both by E. Gerjuoy. (L.M.T.)

4398

New York Univ.

RESEARCH OF FLUORESCENCE AND CONDUCTIVITY PHENOMENA; QUARTERLY PROGRESS REPORT [FOR] AUGUST, SEPTEMBER, AND OCTOBER 1952. Hartmut Kallmann. Submitted Mar. 1953. 76p. (NP-4574; Quarterly Progress Report 7)

Fluorescence of organic compounds, investigations of storage decay, and conductivity investigations of different fluorescent powders are described. Studies of the fluorescence of organic compounds included structural effects on fluorescence,  $\gamma$ -induced fluorescence of dioxane solutions, effects of small amounts of impurities, and phosphorescence of stilbene and anthracene. (For preceding period see NP-4292.) (J.S.R.)

4399

THE MICROSTRUCTURE OF TURBULENT FLOW. A. M. Obukhoff and A. M. Yaglom. Translated from Priklad. Mat. i Mekhan. 15, 3-26(1951). 41p. (NACA-TM-1350)

An attempt is made to describe quantitatively the structure of the velocity, pressure, and acceleration fields for all scales for which the theory of locally isotropic turbulence is applicable. (J.S.R.)

4400

MAGNETIC SUSCEPTIBILITY OF BROMINE-GRAPHITE. R. Smoluchowski. Revs. Modern Phys. 25, 178-81(1953) Jan.

Br, even in small quantities, is known to alter very radically properties of graphite such as conductivity, Hall effect, and others. In particular, the relatively large diamagnetic susceptibility of graphite is rapidly decreased by addition of Br, and the effect cannot be explained by assuming presence of Br in either molecular or atomic form. It appears that this effect can be interpreted in terms of the Brillouin zone structure of graphite. Using Peierls' theory of diamagnetism of free electrons in a solid and Wallace's results concerning the band structure of graphite, an expression is derived which relates the change in the magnetic susceptibility to the change in the number of electrons in the Brillouin zones. The theory is in good agreement with experiment if the effectiveness of Br in accepting electrons is assumed to be that obtained from Hall effect and conductivity data. The probable influence of lattice imperfections is briefly considered. (auth)

4401

POLARIZATION OF BREMSSTRAHLUNG RADIATION. R. L. Gluckstern, M. H. Hull, Jr., and G. Breit. Phys. Rev. 90, 1026-9(1953) June 15.

The dependence of the differential cross section for bremsstrahlung on photon polarization is calculated in the same approximation as the Bethe-Heitler formula for the sum over polarizations. The radiation is found to consist of a



mixture of an unpolarized and a linearly polarized component. The relation of the method of intermediate states to the method of transitions between stationary states is explicitly stated. (auth)

4402

POLARIZATION DEPENDENCE OF THE INTEGRATED BREMSSTRAHLUNG CROSS SECTION. R. L. Gluckstern and M. H. Hull, Jr. *Phys. Rev.* **90**, 1030-5(1953) June 15.

The differential cross section for bremsstrahlung derived in the previous paper (see abstract above) is integrated over the direction of the emerging electron. It is found that regions of appreciable polarization occur near both the low-energy and high-energy ends of the photon spectrum. Calculations are performed for the polarization dependence of the radiation for incident electrons of about 0.1, 0.5, 2.5 Mev with and without approximate shielding corrections calculated for Al. The polarization dependence of the differential cross section for pair production and of the cross section integrated over either the electron or positron direction is obtained from the results for bremsstrahlung by the well-known procedure of changes from positive to negative energy state. (auth)

4403

PRODUCTION OF POLARIZED PARTICLES IN NUCLEAR REACTIONS. A. Simon and T. A. Welton. *Phys. Rev.* **90**, 1036-43(1953) June 15. (cf. NSA 7-2385).

A general calculation of the polarization resulting from nuclear reactions is made by means of the S matrix and Racah formalisms. All sums over magnetic quantum numbers are performed; and the resulting polarization is expressed as a series in associated Legendre polynomials, each coefficient being manifestly real. All selection rules follow immediately from the requirements for the non-vanishing of the Racah and X coefficients. The only restriction required is to a two-body break-up. Higher spin-tensor moments are required for the complete specification of the state of polarization of a beam of particles of spin greater than  $\frac{1}{2}$ . A general expression is given for arbitrary spin moments resulting from a nuclear reaction. The result is expressed as a series in the spherical harmonics with all coefficients being manifestly real. The previous results of Blatt and Biedenharn for the angular distribution follow as a special case of the result. A generalization of the Eisner-Sachs rules for the complexity of angular distributions is also given. (auth)

4404

TRANSMISSION OF ELECTROMAGNETIC WAVES BY A HIGHLY IONIZED GAS. P. Verzaux. *J. phys. radium* **14**, 310-16(1953) May. (In French)

This study has the object of examining the action of certain highly ionized media on the transmission of electromagnetic waves. The intense thermal ionization which is produced in a gas placed at the impact point of two or more shock waves under high pressure (several thousand atm.) is specifically studied. In the first part it is seen what limits can reasonably comprise the degree of ionization. The results obtained agree with the results of previous experiments, especially those of Muraour. Next, the propagation of an electromagnetic wave in an ionized medium is examined. (tr-auth)

# COSMIC RADIATION

4405

PROPERTIES OF THE LOW ENERGY NUCLEONIC COMPONENT AT LARGE ATMOSPHERIC DEPTHS. J. A. Simpson and W. C. Fagot. *Phys. Rev.* **90**, 1068-72(1953) June 15.

This is a report on the absorption properties of the cosmic-radiation low-energy nucleonic component measured by detectors of disintegration-product neutrons as the nucleonic cascade develops deep within the atmosphere. The

air absorption mean free path  $L$  of the star- or neutron-producing radiation was measured as a function of atmospheric depth  $x$  (in  $\text{g-cm}^{-2}$  atmosphere) at the geomagnetic latitudes  $\lambda = 0^\circ, 41^\circ, 52^\circ$ .  $L(x, \lambda)$  was obtained for carbon or free atmosphere and for a Pb + C pile geometry. As reported earlier, for small  $x$  the absorption mfp,  $L$ , is dependent upon  $\lambda$  ( $L$  is a function of the average energy of the primary nucleons which initiate the nucleonic chain or cascade). However, it is shown by the present measurements that, for  $x > 600 \text{ g-cm}^{-2}$ ,  $L \rightarrow \sim 140 \text{ g-cm}^{-2}$  independent of latitude  $\lambda$ . The latitude dependence of neutron-component intensity was measured at  $x = 680 \text{ g-cm}^{-2}$  (11,200 ft) between  $\lambda = 0^\circ$  and  $58^\circ\text{N}$ . The latitude factor of intensity increase is 2.55. In view of the independence of  $L(x)$  on  $\lambda$  at large atmospheric depths this latitude effect is nearly constant down to sea level ( $x = 1030$ ). It is shown that at large atmospheric depths neutron production is observed from primary protons with energies as low as  $\sim 1 \text{ bev}$ . The specific yield of neutrons at 11,200 ft has been computed taking into account protons,  $\alpha$  particles, and heavier primary nuclei. These measurements resolve discrepancies reported in the literature between high-altitude measurements and measurements between sea level and mountain altitudes for the low-energy nucleonic component. (auth)

4406

WORLD-WIDE CHANGES IN THE PHASE OF THE COSMIC-RAY SOLAR DAILY VARIATION. T. Thambyahpillai and H. Elliot. *Nature* **171**, 918-20(1953) May 23.

Cosmic-ray measurements were made at Manchester, England, with an apparatus consisting of two counter telescopes with wide angles of acceptance, one pointing south and the other to the north and inclined at  $45^\circ$  to the vertical. Comparison with previous measurements indicates that the time of maximum for the south-pointing telescopes has fallen progressively earlier in the day from 1940 to 1952. There is a similar but less marked trend for the north direction. Measurements made in other parts of the world over several years reveal a systematic change in phase. The time of maximum fell progressively later from 1933 to 1942, and then the time of maximum has become gradually earlier from 1942 up to the present. No definite conclusion can be drawn as to the periodicity of the phase change. (L.T.W.)

4407

CLOUD CHAMBER OBSERVATIONS OF THE COSMIC RADIATION UNDERGROUND. E. P. George, J. L. Redding, and P. T. Trent. *Proc. Phys. Soc. (London)* **A66**, 533-40 (1953) June 1.

In a study of the passage of fast charged particles through a cloud chamber containing two Pb plates at a depth below ground equivalent to 60 m water, examples of associated pairs of penetrating particles and of large angle scattering of single particles have been observed. If these events are interpreted as the production of secondary particles by  $\mu$  mesons, and as anomalous scattering of  $\mu$  mesons in Pb, the following cross sections per nucleon result: for penetrating secondary particles  $4 \times 10^{-29} \text{ cm}^2$ , and for anomalous large-angle scatter  $2 \times 10^{-28} \text{ cm}^2$ . (auth)

4408

THE LATERAL STRUCTURE OF COSMIC RAY EXTENSIVE AIR SHOWERS AT SEA LEVEL. S. R. Haddara and D. Jakeman. *Proc. Phys. Soc. (London)* **A66**, 549-58(1953) June 1.

The axes or cores of extensive air showers have been selected by observing in a cloud chamber cascade showers produced by a single high-energy ( $> 5 \times 10^9 \text{ ev}$ ) electron or photon, and an upper limit of 5 m for the spread of such particles has been found. By placing trays of hodoscoped counters at various distances from this core selector it



has been possible to determine the relation between density of ionizing particles and distance from the axis for showers of approximately  $10^4$ – $10^5$  particles. The experimental arrangement and method of analysis used have certain advantages over those employed by other workers. It is concluded that although the results of the present experiment and those of other workers are consistent with the Molière structure function, not too much weight should be placed on this agreement. (auth)

4409

OBSERVATION IN PHOTOGRAPHIC EMULSIONS OF "JETS" OF LARGE AND SMALL APERTURE. Constance Dilworth, Simon Goldsack, Tchang-Fong Hoang, and Livio Scarsi. *Compt. rend.* **236**, 1551-3(1953) Apr. 20. (In French)

A statistical analysis of the number of charged mesons emitted in 47 stars (jets) having no more than two heavy branches shows that these may be divided into two groups. In one, the multiplicity is clearly proportional to the energy of the primary (jets of large aperture), while for the other (jets of small aperture) the multiplicity increases very slowly with the energy of the primary. Several explanations are considered. (G.Y.)

#### ELECTRICAL DISCHARGE

4410

SOME PROPERTIES OF HYDROGEN SPARK CHANNELS. R. D. Craig and J. D. Craggs. *Proc. Phys. Soc. (London)* **B66**, 500-11(1953) June 1.

Measurements of voltage gradients and visible channel diameters for H sparks (100-200 A, rectangular current pulses) at 1 atm. pressure, are described. The results are discussed in terms of the physical properties, such as the gas temperature, of the channel. It appears from the drift-current equation, on insertion of measured values of current and electron density, that the electron-drift velocity fits a constant pressure (arc-like) condition for the channel better than a constant density condition. The results are consistent with a channel temperature of about 15000°K. Diffusion processes, in the later stages of spark-channel expansion, are also discussed. (auth)

4411

SPARKING VOLTAGE OF GAS DISCHARGE UNDER THE INFLUENCE OF A TRANSVERSE MAGNETIC FIELD IN THE PRESSURE RANGE FROM 10 TO  $10^{-8}$  mm Hg. R. Haefer. *Acta Phys. Austriaca* **7**, 52-90(1953) Apr. (In German)

It has been proven experimentally that sparking of a stable electrical gas discharge under the influence of a magnetic field transverse to the electric field takes place down to the lowest measurable pressure ( $10^{-8}$  mm Hg). A cylindrical electrode arrangement with a coaxial field was used, the outer cylinder being the cathode. A voltage of 2200 v was sufficient to cause sparking at  $1.5 \times 10^{-8}$  mm Hg in a strong magnetic field. The results and theory are considered in detail. (G.Y.)

#### INSTRUMENTS

4412

North American Aviation, Inc.

AN APPARATUS FOR THE PRECISE MEASUREMENT OF MAGNETIC SUSCEPTIBILITIES BY THE FARADAY METHOD. J. J. Donoghue. Submitted Feb. 25, 1953. 46p. (NAA-SR-117)

An apparatus is described which takes advantage of a uniform force field and new calibration procedures to provide precise comparisons of magnetic susceptibilities. The sensitivity is adequate for the study of the changes produced by radiation damage in very small specimens.

The pole tips of the electromagnet are accurately machined to two of the calculated equipotentials in a uniform force field, thus making the susceptibility independent of changes in the position or in the shape of the specimens. Two new steps are employed in the calibration to assure true consistency and precision of the determinations. The first employs a pure diamagnetic and a pure paramagnetic specimen to detect and eliminate the effect of systematic errors made in determining the field strengths and the derived constants of the apparatus. As a result, traces of ferromagnetic impurities, detected by the method of Honda and Owen, are determined accurately. The second step detects and eliminates any false dependence of the susceptibility on the degree of ferromagnetic impurity. A test for the consistency of the calibration of any Faraday-type apparatus is proposed, utilizing anisotropic specimens. Data for six pure metals are presented for comparison with values reported in the literature. (auth)

4413

RADIOFREQUENCY POWER SUPPLY. E. M. Reilley, R. S. Bender, and H. J. Hausman. *Rev. Sci. Instr.* **23**, 572-3 (1952) Oct.

A circuit diagram is presented of a high-voltage power supply having a maximum current output of 500  $\mu$ a for use with any equipment wherein very high d-c stability of the supply voltage is essential. The input to the regulation section of the supply is furnished by a d-c amplifier wired as a difference amplifier, the d-c reference voltage being supplied by a 5651 voltage regulator tube operating at constant current. An output voltage from 500 to 3000 v is obtained by use of a wire-wound resistance chain. The d-c output voltage measured over a period of 48 hr shifted  $<2$  parts in 10,000. (L.M.T.)

4414

POTENTIAL OF AN ELECTROSTATIC ELECTRON LENS; COMPARISON OF THE NUMERICALLY CALCULATED RESULTS AND OF MEASUREMENTS MADE WITH AN ELECTROLYTIC CELL. M. Laudet and P. Pilod. *J. phys. radium* **14**, 323-8(1953) May. (In French)

The distribution of potential in a circular-symmetrical electrostatic electron lens was studied by the numerical method of relaxation and with an electrolytic analog. The possibilities of the two methods are discussed from the point of view of precision and convenience of use. (tr-auth)

4415

AN INFRARED ISOTOPE ANALYZER. J. C. Kluyver and J. M. W. Milatz. *Physica* **19**, 401-11(1953) May. (In English)

The shift in the infrared absorption bands of isotopic molecules is used in a new method for determining the isotope ratios in tracer experiments. The infrared absorption is measured with a nondispersive filter instrument containing as selective detector a gas cell filled with a concentrated sample of the component to be measured. An instrument is devised according to this method, to measure the  $C^{13}/C^{12}$  ratio in  $CO_2$ . It permits the measurement of the  $C^{13}$  abundance in 30 mg  $CO_2$  with an error of 0.005 at. % in the neighborhood of the natural abundance of 1.1 at. %. This precision is sufficient for the majority of tracer experiments. (auth)

#### ISOTOPES

4416

THE ISOTOPIC CONSTITUTION OF SILICON, GERMANIUM, AND HAFNIUM. John H. Reynolds. *Phys. Rev.* **90**, 1047-9(1953) June 15.

The isotopic constitutions of Si, Ge, and Hf have been measured with a mass spectrometer by techniques which are described. Results for Si are in good agreement with



certain of the earlier determinations but are in poor agreement with the values adopted in the recent compilation by Bainbridge and Nier. Results for Ge do not differ significantly from earlier determinations. Results for Hf differ only slightly from the one previous determination in which electrical detection was used, but in such a way as to suggest that determinations on Hf which has been fractionally purified with respect to Zr may not be faithfully representative of the true abundances. An upper limit of 0.003% has been placed on the abundance in nature of Hf<sup>182</sup>. (auth)

#### ISOTOPE SEPARATION

4417

THEORETICAL DELIVERY OF A SPIRAL THERMODIFFUSION COLUMN. Paul Renaud. *Compt. rend.* **236**, 1555-7(1953) Apr. 20. (In French)

The example studied is the natural HCl<sup>35</sup>-HCl<sup>37</sup> mixture. The delivery is calculated by means of classical equations and certain simplifying hypotheses. The velocity of thermodiffusion, unknown for HCl, has been replaced by that calculated for CH<sub>4</sub>. This cause of error modifies the order of magnitude very little. An apparatus 50 cm in diameter delivers 100 g/day of 80% Cl<sup>37</sup>. (tr-auth)

#### MASS SPECTROGRAPHY

4418

THE CONTROL AND STABILIZATION OF THE MAGNETIC FIELD FOR A MASS SPECTROMETER. N. T. van der Walt. *Rev. Sci. Instr.* **24**, 413-16(1953) June.

A method is described by means of which the magnetic field for a mass spectrometer is stabilized to within one part in 25,000 over a period of 30 minutes at any value of flux density within its variable range of 580 gauss to 9.3 kilogauss. (auth)

#### MEASURING INSTRUMENTS AND TECHNIQUES

4419

Atomic Energy Project, Univ. of Calif., Los Angeles  
DEVELOPMENT OF CHEMICAL SYSTEMS APPLICABLE TO PRODUCTION OF THE ARMY TACTICAL AND ORGANIZATIONAL DOSIMETERS: QUARTERLY REPORT [FOR] OCTOBER 1, 1952-JANUARY 1, 1953. George V. Taplin, Clayton H. Douglas, Sanford C. Sigoloff, Donald Wales, Donald Paglia, and Charles Heller. Jan. 1, 1953. 49p. (AECU-2574; Quarterly Report 2)

Present information indicates that the chloroform-resorcinol(0.2%)-bromocresol purple system meets minimum Army Chemical Corps requirements in respect to heat stability, dosage rate, temperature, and energy independence, radiation sensitivity, resistance to sunlight, readability, and adaptability to the manufacture of the four-step 50, 200, 400, and 600 r dosimeter tubes needed in the Army Tactical Dosimeter. At least three additional systems embodying tetrachloroethylene as their basic radiation sensitive agent have been studied and found almost ideal for the same purpose. These systems have the valuable property of being highly thermostable. They are applicable not only to the manufacture of the Army Tactical and Organizational dosimeters, but also to the possible development of the Army Technical dosimeter, and to similar instruments needed by radiation monitoring units of Civil Defense agencies for estimating accumulated doses of contaminating radiation following atomic explosions. Several methods have been explored for the preparation of a color-comparator dosage reader for use with the Army Organizational dosimeter. Two main types of reader devices have been made in prototype form, both of which employ methods that are feasible for inexpensive manufacture on a large scale. One is the comparator using

sealed tubes containing the buffered dye solutions. The other comparator employs disks of colored polystyrene which match the color changes in the dye used in the dosimeter system. Development of quantitative spectrophotometric methods for determining the amounts of  $\gamma$  radiation exposure in chloroform-resorcinol-dye dosimeter systems has been accomplished. Several hundred special chloroform-resorcinol-dye dosimeters have been prepared and forwarded to various agencies to have this basic system evaluated for the variability of its response when exposed to high-energy sources which have an extreme range of  $\gamma$ -ray intensity. (For preceding report in series see NP-4272 (NSA 7-1085).) (auth)

4420

Department of Mines and Technical Surveys, Mines Branch, Ottawa (Canada)

A RADIOMETRIC ASSAY UNIT FOR BAGGED RADIO-ACTIVE ORE. A. H. Bettens and G. G. Eichholz. May 4, 1953. 14p. (NP-4617; TR-110/53)

A compact assay unit is described for assaying radio-metrically the U content of coarse bagged ore. The detector consists of a long cylindrical tube containing an organic phosphor solution with a 5819 photomultiplier tube at each end. The output from the phototubes is amplified, mixed, and applied to a commercial ratemeter. Gamma assays down to 0.005% U<sub>3</sub>O<sub>8</sub> can be obtained for 50-lb samples in about two minutes each. (auth)

4421

RUGGED SCINTILLATION-COUNTER HOUSING FOR BIOLOGICAL APPLICATIONS. Luther E. Preuss. *Nucleonics* **11**, No. 6, 74-5(1953) June.

A rugged scintillation-counter housing is described, which can be quickly assembled in a dry box. (J.S.R.)

4422

A PILE PERIOD OR REACTIVITY METER. T. E. Burnup and J. H. Bowen. *Electronic Eng.* **25**, 190-1(1953) May.

The "discontinuous period meter" which is described incorporates a primary measuring element (usually an ion chamber) for determining the neutron density at a point, an instrument for measuring the time interval, and a device for measuring the neutron-density ratios. In addition to the equilibrium accuracies of these three sections of the instrument, the dynamic characteristics are also discussed. (L.T.W.)

4423

A-C OPERATION OF ION CHAMBERS. A. H. Ward. *Nature* **171**, 837(1953) May 9.

Two  $\gamma$ -sensitive ion chambers, filled with A at 20 atm., are connected in opposition as 2 arms of an a-c bridge; each balance arm consists of adjustable capacity and parallel resistance. The bridge is fed with 10 cps at 24 v. Out-of-balance current is detected by an amplifier with electrometer triode input; the amplified signal is led to a gate pentode where it is filtered for both frequency and phase, and the smoothed anode current measured on the output meter. The bridge is easily balanced to eliminate all capacitive current through the ion chambers, and much of the cosmic background current as well. Irradiation of either chamber causes additional resistance current to flow in the chamber. The output meter shows a change in reading proportional to the radiation intensity over a small range. (L.T.W.)

4424

LIQUID SCINTILLATION COUNTING OF TRITIUM-LABELED WATER AND ORGANIC COMPOUNDS. F. N. Hayes and R. Gordon Gould. *Science* **117**, 480-2(1953) May 1.

A procedure is described for the liquid scintillation counting of tritium-labeled water and organic compounds

using a fast coincidence instrument. 2,5-Diphenylvloxazole is employed as the solute with toluene, dioxane, and xylene as the major solvents. The standard practice is to use 100 mg solute in a total volume of 30 ml solution. Miscibility of tritium-labeled water with toluene or xylene is achieved by the addition of absolute ethanol. Contamination difficulties are minimized by the use of 45 mm x 65 mm pvrex weighing bottles as sample containers. Scintillation-counting data for tritium-labeled sterols and data on the efficiency of the scintillation counting of tritium-labeled water in various solvent mixtures are included. (C.H.)

4425

LIMITATION OF THE PROPAGATION OF THE DISCHARGE IN G-M COUNTERS. E. Picard and A. Rogozinski. *J. phys. radium* **14**, 304-6(1953) May. (In French)

An apparatus having only one double triode, which confines the discharge produced in the tube to a limited portion of the wire, is described. The reaction occurs in less than  $10^{-7}$  sec after the start of the discharge and lasts  $\sim 2 \times 10^{-6}$  sec. The advantages which follow from limitation of the discharge are: an increase in the life of the counter, a decrease in its dead time, and a reduction of the number of parasitic impulses. (tr-auth)

4426

ANGULAR DEPENDENCE OF THE LIGHT SCATTERING IN A SINGLE CLOUD CHAMBER; MEASURED BY THE MESON PATH OF COSMIC RADIATION IN THE WILSON-CHAMBER. Martin S. Elsaesser and Karl Wirtz. *Z. angew. Phys.* **5**, 133-9(1953) Apr. (In German)

The angular dependence of light scattering from a cloud chamber filled with an alcohol-water mixture was investigated by measuring the path (by photographic methods) of a single fast particle of cosmic radiation in a Wilson Chamber. The conditions corresponded to those of the usual Wilson Chamber technique: the parallel light of a gas-discharge flashlight was laterally scattered and photographed by means of several similar synchronized cameras under different angles. The darkening of the film was related to the light intensity. By means of a special evaluation process scattered light was eliminated from the chamber background. For angular scattering between 50 and 90° the scattering intensity is lowered by a factor of  $\sim 7$ . The results were compared with those from natural and artificial clouds. Individual measurements excluded secondary scattering. (tr-auth)

## MESONS

4427

MASS OF COSMIC-RAY MESONS AT MOUNTAIN ALTITUDES. Giulio Ascoli. *Phys. Rev.* **90**, 1079-87(1953) June 15.

Mass measurements of cosmic-ray particles have been carried out by cloud-chamber observations at 3240-m elevation to determine the relative rate of occurrence of mesons of different types, in particular of  $\mu$  mesons of the hard component and of  $\pi$  mesons produced locally above the apparatus. From momentum and range observations, the mass of individual particles could be obtained with a probable error of 5%, thus allowing accurate resolution between  $\mu$  and  $\pi$  mesons. The results of 48 observations indicate that all of the particles were very probably  $\mu$  mesons. The data yield a  $\mu$ -meson mass value of  $207.4 \pm 2.4 m_e$ , where the probable error includes an estimate of systematic errors. The observed absence of  $\pi$  mesons in the experiment is in agreement with the results of observations in photographic plates. In addition, a single cloud-chamber observation was obtained which suggests the existence of a particle having a positive charge twice the elementary charge and a mass roughly equal to that of a

nucleon. Alternative interpretations of the observation are discussed in detail. (auth)

4428

THE PRODUCTION OF HEAVY MESONS. L. S. Kothari. *Phys. Rev.* **90**, 1087-9(1953) June 15.

Using Fermi's theory of multiple production, the production of heavy mesons in a nucleon-nucleon collision (with primary energy  $< 20Mc^2$ , where  $M$  is nucleon mass) is studied. One obtains the result that heavy mesons should be produced singly about 10 times more frequently than in pairs. Creation of mesons in a meson-nucleon collision is also considered, and it is found that mesons of energy  $E < Mc^2$  would, most likely, pass through nuclear matter without further creation of mesons, while for  $E > 2Mc^2$  the probability of multiplication is large. In a qualitative way, the results deduced seem to agree rather well with experiments. (auth)

4429

IONIZATION OF COSMIC RAY MESONS IN ARGON. J. K. Parry, H. D. Rathgeber, and J. L. Rouse. *Proc. Phys. Soc. (London)* **A66**, 541-8(1953) June 1.

The ionization by cosmic-ray mesons with momentum in the range  $3 \times 10^8$  to  $7 \times 10^{10}$  ev/c is investigated using an A-filled proportional counter. The results obtained are in agreement with theoretical calculations and show evidence of a polarization effect. (auth)

4430

FERMI'S THEORY OF NUCLEON COLLISIONS AND THE ZERO-POINT ENERGY OF PIONS. F. C. Auluck and D. S. Kothari. *Phys. Rev.* **90**, 1002-3(1953) June 1.

Fermi (*Progr. Theoret. Phys. (Japan)* **5**, 570(1950)), on the basis of statistical thermodynamics, gave a theory to account for the production of pions (and also nucleons) in collisions of high-energy nucleons. In this note the effect of the zero-point energy of the pions is taken into account; this was not done in Fermi's treatment. (L.M.T.)

4431

AN EXAMPLE OF MULTIPLE MESON PRODUCTION OBSERVED WITH A HIGH PRESSURE HYDROGEN-FILLED CLOUD CHAMBER. Osamu Kusumoto, Saburo Miyake, Koichi Suga, and Yuzuru Watase. *Phys. Rev.* **90**, 998-9(1953) June 1.

A counter-controlled high-pressure cloud chamber filled with  $H_2$  gas to a pressure of 100 atm. and operating at 2740 m altitude was used to observe a nuclear event which was thought to be multiple meson production from a p-p collision. The most probable description of the event is thought to be  $p + p \rightarrow p + n + \pi^+ + \pi^- + \pi^+$ . (L.M.T.)

4432

PRODUCTION OF MESONS IN PASSAGE [OF PHOTONS] THROUGH MATTER. A. Florian. *Acta Phys. Austriaca* **7**, 23-51(1953) Apr. (In German)

Supplementing an earlier work (*Acta Phys. Austriaca* **1**, 55 (1947)), the reaction cross section for vector mesons is calculated, two new intermediate states being assumed. The presence of an antiproton in the intermediate state is considered, on the basis of work by Belinfante (thesis, Leyden, 1939), who formulated the respective interaction terms. The calculation is carried out as far as possible without additional neglect of terms. The calculation indicates a necessary separation into low and high energies of the incident photons. The total cross section is given for the case of low energies. The case of high energies leads to very complex derivations and will be reserved for a later work. (tr-auth)

4433

ON THE  $\chi$ -MESON. Kenzo Inoue. *Progr. Theoret. Phys. (Japan)* **9**, 323-4(1953) Mar.



The decay mode for the  $\chi$  meson is assumed to be  $\chi^\pm \rightarrow \mu^\pm + N + \bar{N} \rightarrow \mu^\pm + \pi^0 + N' + \bar{N} \rightarrow \mu^\pm + \pi^0 + \pi^0$ , where  $N, N', \bar{N}$  represent the nucleons and antinucleon, respectively. The value of the coupling constant is estimated to be  $G \sim 15 \times 10^{-49}$  erg cm<sup>3</sup>. (L.T.W.)

4434

PION PRODUCTION RATIOS BY PROTON BOMBARDMENT. Ryokichi Sagane. *Phys. Rev.* 90, 1003(1953) June 1.

The  $\pi^+/\pi^-$  production ratios at 90° from 340-Mev proton bombardment of Pb, Ag, Cu, Al, C, and Be are presented. A rough computation of relative cross sections for 42-Mev  $\pi^+$  mesons showed a curve proportional to  $Z^{3/2}$ . (L.M.T.)

## NEUTRONS

4435

Brookhaven National Lab.

LONG LIVED DELAYED NEUTRONS FROM FISSION.

J. W. Kunstadter, J. J. Floyd, and L. B. Borst. [Mar. 27, 1953] 14p. (BNL-1411)

Low-intensity delayed neutrons from U have been observed with half lives of 3, 12, and 125 min and yields per fission of  $5.8 \times 10^{-8}$ ,  $5.6 \times 10^{-10}$ , and  $2.9 \times 10^{-10}$ , using foil-activation techniques. (auth)

4436

ON THE INFLUENCE OF SPIN AND ISOTOPES IN THE KINEMATICAL THEORY OF NEUTRON DIFFRACTION.

Per Olof Fröman. *Arkiv Fysik* 6, 113-17(1953). (cf. NSA 7-685).

A general formula is derived which takes into account the effects of temperature, spin, and isotopic disorder on the diffraction of slow neutrons by single crystals in which the magnetic interaction between the neutron and the scattering nuclei can be neglected. (auth)

## NUCLEAR PROPERTIES

4437

[Purdue Research Foundation]

INDICATIONS OF THE INTERACTION OF ELECTRIC FIELD GRADIENTS AND NUCLEAR ELECTRIC QUADRUPOLE MOMENTS IN ANGULAR CORRELATION. Rolf M. Steffen. [1953] 6p. (AECU-2588)

It has been generally assumed that the interaction between the nuclear magnetic dipole moment and magnetic fields, due to either the electron shell or the surrounding of the decaying atom, is mainly responsible for the reduction of the  $\gamma$  angular correlation. However, several directional correlations have been reported recently in which the reduction of the anisotropy of the correlation could not be understood on the basis of the magnetic interaction alone. In this paper magnetic decoupling experiments with a magnetic field of 7000 gauss applied in the direction of propagation of one  $\gamma$  ray of Cd<sup>111</sup> showed no tendency to restore the maximum directional correlation. This result seems to indicate that the attenuation of the Cd<sup>111</sup> correlation in solid sources is due to the interaction between the crystalline grad E field and the electric quadrupole moment of the 0.247-Mev excited state of Cd<sup>111</sup>. (L.T.W.)

4438

Oak Ridge National Lab.

GAMMA-RAY TOTAL MASS ABSORPTION COEFFICIENTS.

M. K. Hullings. Feb. 12, 1953. 5p. (CF-53-2-266)

Tables of the  $\gamma$ -ray total mass-absorption coefficients have been obtained for the elements up to U for energies of 0.5, 1.0, 2.0, 3.0, and 6.0 Mev. A complete listing of the values obtained is given. (J.S.R.)

4439

Radiation Lab., Univ. of Calif., Berkeley

SUMMARY OF RESEARCH PROGRESS MEETING OF

SEPTEMBER 25, 1952. Sergey Shewchuck. Dec. 18, 1952. 5p. (UCRL-2058)

A discussion by Richard A. Glass of the evaluation of the parameters for the Bohr-Wheeler parabolas in the trans-Pb region, from accurately measured  $\beta$  energies, is briefly reported. (L.T.W.)

4440

DIFFERENCE BETWEEN THE DENSITY DISTRIBUTION OF NEUTRONS AND PROTONS IN ATOMIC NUCLEI. P. Gombás. *Nature* 171, 979-80(1953) May 30.

The neutron and proton density distributions in nuclei were obtained by Ritz's method assuming Yukawa forces between the nucleons. A small difference between the neutron and proton density was found. The density functions are of the gaussian type. No justification was found for supposing there to be a tendency to form a hole in the center of the nucleus, resulting from coulomb repulsion of protons. (L.T.W.)

4441

INVESTIGATION OF NUCLEAR MOTION BY ELECTRON DIFFRACTION. L. S. Bartell and L. O. Brockway. *Nature* 171, 978-9(1953) May 30.

It is pointed out that atomic phase shifts must be taken into consideration in the calculation of nuclear vibrational amplitudes. (L.T.W.)

4442

NUCLEAR HYPERFINE STRUCTURE OF Mn<sup>++</sup>. Mendel Sachs. *Phys. Rev.* 90, 1058-60(1953) June 15.

A theoretical calculation of the nuclear hyperfine splitting in Mn<sup>++</sup> is made on the assumption that the ground state is composed of a mixture of the normal electronic configuration and a state created by moving an inner 3s electron to the 4s state. The ground-state wave function is then written as

$$\Psi = (1 - \alpha^2)^{1/2} \psi(3s^2 3d^5) + \alpha \psi(3s 3d^5 4s).$$

The numerical calculation of  $\alpha$  is limited primarily by the inaccuracy of the values of the 3s and 4s radial wave functions at the nucleus. The observed splitting is obtained for the value  $\alpha^2 \approx 4.41 \times 10^{-4}$ . The calculation was carried out by assuming a jj-coupling model. (auth)

4443

EFFECT OF NUCLEAR STRUCTURE UPON THE STATISTICAL LAW OF BINDING ENERGY. R. Bouchez, J. Robert, and J. Tobaillem. *J. phys. radium* 14, 281-94(1953) May. (In French)

The parabolic law of the binding energy of nuclei, deduced from a statistical model for the nucleus (Bethe-Weizsäcker equation), explains neither the energy of the individual nuclei nor, in many cases, their energy variation. Moreover, a detailed analysis of the energies of  $\beta$  disintegration shows some important variations and irregularities from the statistical law for the parameters  $Z_A$ ,  $B_A$ ,  $\delta_A$ . An empirical study, based on the modifications of nuclear structure, is necessary to apply the parabolic statistical law in order to reduce the irregularities and to obtain a monotonic variation of the parameters which define it. For the nuclei of odd A ( $A > 40$ ) it is possible in a first approximation to represent by the regular laws the variations of the binding energy. One particular law ( $Z_A$ ,  $B_A$ ) is then valid only for the nuclei enclosed between two binding-energy discontinuities due to neighboring nuclear levels. Moreover, the nuclei of odd Z and odd N are found upon the parabolas parallel to, and distant from,  $\epsilon_A$ . The functions  $Z_A$ ,  $B_A$ , and  $\epsilon_A$  are determined empirically. Between the discontinuities, the parameters vary more regularly; the effect of the nuclear levels is observed principally on  $Z_A$ ,

but also on  $B_A$  and  $\epsilon_A$ . For the nuclei of even  $A$ , there does not exist a regular law for the parameter  $\delta_A$ ; however, the effect of the nuclear levels is again very apparent. This parameter, which depends principally on the binding energy of nucleon pairs, in the singlet or triplet spin state, ought to be analyzed to take account of the space states for each nucleon of a pair; in particular, the passage from a level by a nucleon and the formation of an  $\alpha$  group changes in an appreciable way the magnitude of  $\delta_A$ . The results obtained are compared with those of an analogous study done recently by Coryell. (tr-auth)

4444

SPINS AND PARITIES OF EXCITED STATES IN EVEN-EVEN NUCLEI. I. Michael J. Glaubman. Phys. Rev. **90**, 1000(1953) June 1.

From a consideration of excited states of several even-even nuclei, both with excited configurations and with the ground-state configurations, the following generalization is made: in even-even nuclei the low-lying odd-parity states have odd spins and the low-lying even-parity states have even spins. In the case of the 2.73-Mev level in  $\text{Mo}^{94}$  and the 0.764-Mev level in  $\text{Os}^{186}$  odd-spin even-parity assignments have been made, but it is thought that these probably should be interpreted as  $2^+$  states. Also in the cases of the 3.75-Mev level in  $\text{A}^{38}$  and the 2.185-Mev level in  $\text{Nd}^{144}$ , the spin is odd but the parity assignment is doubtful. A definitive determination of these parities would provide a useful check for the rule suggested. (L.M.T.)

4445

SPINS AND PARITIES OF EXCITED STATES IN EVEN-EVEN NUCLEI. II. Igal Talmi. Phys. Rev. **90**, 1001(1953) June 1.

Theoretical explanation is given of the rule proposed (see preceding abstract) that in even-even nuclei the low-lying levels of excited configurations with odd parity have odd spins whereas the low-lying levels of configurations with even parity (a special case of which is the ground-state configuration) have even spins. (L.M.T.)

4446

ODD-ODD SPINS AND  $j$ - $j$  COUPLING. R. W. King and D. C. Peaslee. Phys. Rev. **90**, 1001-2(1953) June 1.

Odd-odd nuclei with neutrons and protons filling equivalent shells have the unique feature of providing evidence both for and against the  $j$ - $j$  coupling scheme in nuclei. When the spins of these nuclei are plotted against  $A$ , they show a regularly repeating pattern with a periodicity that exactly matches the ranges of the  $j$ - $j$  subshells  $p_{3/2}$ ,  $d_{5/2}$ , and  $f_{7/2}$ . At the same time, the pattern entirely fails to show the symmetry within a given subshell that would be demanded by perfect  $j$ - $j$  coupling. If  $j$ - $j$  coupling were ideally followed, the pattern of odd-odd spins should be entirely symmetric with respect to holes and particles within the subshells; the empirical pattern, however, is that the spins tend to increase continuously throughout the filling of each subshell. This is illustrated when the spins of odd-odd nuclei having neutrons and protons in equivalent shells are plotted against the total number of particles in the subshell. (L.M.T.)

4447

SPECTROGRAPHIC DETERMINATION OF NUCLEAR QUADRUPOLE MOMENTS. I. I. Gol'dman. Doklady Akad. Nauk S.S.S.R. **88**, 241-3(1953) Jan. 11. (In Russian)

An evaluation of the screening effect must be made before any consideration of hyperfine structure is made. The method of calculation of this effect is given. The calculated correction factor for the screening effect was verified experimentally by the investigation of the spectral lines of several elements. (J.S.R.)

4448

CALCULATION OF NUCLEAR BINDING ENERGIES WITH SINGLE-PARTICLE OSCILLATOR WAVE FUNCTIONS. Erwin H. Kronheimer. Phys. Rev. **90**, 1003-4(1953) June 1. Pease and Feshbach (Phys. Rev. **81**, 142(1951); **88**, 945(1952)) proposed a phenomenological interaction which was fitted to the singlet potential, the deuteron quadrupole moment and binding energy, and the binding energy of  $\text{H}^3$  and which was found to predict the triplet effective range satisfactorily. To investigate more closely the binding predicted by this interaction for light nuclei, more states, mixed configurations, and wave functions made more flexible by the introduction of different oscillator parameters into the different single-particle states must be considered. Formulas which have been developed toward this end are presented. (L.M.T.)

4449

A NEW VARIATION OF THE ROTATION-BY-MAGNETIZATION METHOD OF MEASURING GYROMAGNETIC RATIOS. C. J. Davisson and J. W. Beams. Revs. Modern Phys. **25**, 246-52(1953) Jan.

Alterations in the experimental arrangement of the rod and fiber method for measuring gyromagnetic ratios are described. In the new arrangement the rod is replaced by torsionless magnetic suspension, and solenoids of the usual kind are replaced by a pair of air-cored electromagnets mounted on a common vertical axis. The point of suspension, which is in vacuum, is at the center of symmetry of this pair of coils. Lateral stability is provided over a wide range of operating conditions by the form of the field. Longitudinal stability is achieved by automatic control of the current in the upper coil. This is the rectified output of a r-f vacuum tube circuit. Calculations necessary to evaluate the gyromagnetic ratio from experimental observations are shown. (L.T.W.)

4450

OPTICALLY INDUCED NUCLEAR MAGNETIZATION. A PROGRESS REPORT. F. Bitter, R. F. Lacey, and B. Richter. Revs. Modern Phys. **25**, 174-7(1953) Jan.

An attempt has been made to produce a high degree of nuclear orientation in  $\text{Hg}^{199}$  vapor by the absorption of circularly polarized resonance radiation. A method is described for detecting the nuclear orientation by observing the intensity of the  $\pi$  component of the resonance radiation. No indication of orientation was found. The probable cause for this failure is considered to be the imprisonment and consequent depolarization of the effective component of the resonance radiation. (auth)

4451

ISOTOPE SHIFT IN THE RESONANCE LINES OF YTTERBIUM. K. Krebs and H. Nelkowski. Naturwissenschaften **40**, 268(1953) May. (In German)

The hyperfine structures of several lines of the Yb spectrum are illustrated, and preliminary values for the isotope shifts are reported. (G.Y.)

4452

THEORY OF SPIN-MEDIUM BROADENING IN QUADRUPOLE RESONANCE. Yves Ayant. Compt. rend. **236**, 1553-5(1953) Apr. 20. (In French)

Expressions are derived for the broadening of nuclear quadrupole resonance lines caused by spin-medium coupling. The results are applied numerically to  $\text{I}^{127}$ ,  $\text{Sb}^{121}$ , and  $\text{Sb}^{123}$ . (G.Y.)

# NUCLEAR REACTORS

4453

Oak Ridge National Lab.

THE KINETICS OF THE CIRCULATING-FUEL NUCLEAR



REACTOR. W. K. Ergen. Mar. 30, 1953. Decl. June 4, 1953. 39p. (AECD-3526; CF-53-3-231)

In a circulating-fuel reactor the circulation of the fuel causes a damping of power oscillations of the reactor. This is demonstrated under the assumption that there is no mechanical vibration coupled with the oscillation of reactor power and that the shape of the hydrodynamic flow does not vary with time. (auth)

4454

[Knolls Atomic Power Lab.]

THE THERMAL TEST REACTOR OF THE KNOLLS ATOMIC POWER LABORATORY. Lewi Tonks. [nd] Decl. with deletions June 9, 1953. 23p. (AECD-3530)

Extensive modifications in the KAPL Thermal Test Reactor have resulted in a new model. The operating power level has been raised to 10 kw, and improvements have been made in experimental facilities. The fuel is U-Al alloy containing enriched U. The new reactor is described and illustrated. 11 figures. (C.H.)

4455

Brookhaven National Lab.

[SELECTION OF MATERIALS AND EQUIPMENT FOR REACTORS.] PART 5. RESEARCH USE OF A NUCLEAR REACTOR. Marvin Fox. [1953] 11p. (BNL-1359)

A brief, general discussion is presented of some aspects of design and facilities necessary for any research reactor, and a few general statements are made concerning areas of research possible with such a reactor. (G.Y.)

4456

NUCLEAR REACTOR CATALOG. H. S. Isbin. Nucleonics 11, No. 6, 65-9(1953) June. (cf. NSA 6-5196)

A chart summarizes the unclassified features of reactors which are already in operation or are in advanced stages of design or construction. (J.S.R.)

4457

NUCLEAR POWER FEASIBILITY STUDIES. Nucleonics 11, No. 6, 49-64(1953) June.

After a year's study, four industrial teams present design and cost data for reactor-powered electrical generating stations. The studies were limited by two conditions: the reactor should be dual-purpose, producing both electricity and Pu, and the reactor should be designed for construction within the next few years. Commonwealth Edison Co.-Public Service Co. of Northern Ill. The two reactor types preferred by this team were a gas-cooled, graphite-moderated plant and a heavy-water-moderated and -cooled reactor. The components are given for the gas-cooled, graphite-moderated reactor, which could be built with a minimum of development work. However, this team believes that a heavy-water-cooled and -moderated reactor, the operation and design of which is described, has the best economic possibilities at present. Pacific Gas and Electric Co.-Bechtel Corp. Two reactors were chosen for detailed study. The light-water cooled, heavy-water-moderated reactor and the liquid-metal-cooled fast reactor. The first has immediate technical feasibility, but the latter shows greater promise as a future power reactor. The essential elements of each reactor are discussed, and a comparison is made of the costs. Dow Chemical Co.-Detroit Edison Co. The specifications for economical nuclear power are given, and the reactor types which meet the requirements are discussed. This team prefers a liquid-metal-cooled reactor. Monsanto Chemical Co.-Union Electric Co. The characteristics of a liquid-metal-cooled reactor, preferred by this team, are given. Problems which require developmental study before construction and operation of a reactor are listed. (J.S.R.)

4458

USE OF A REACTOR FOR RESEARCH. Marvin Fox. Nucleonics 11, No. 6, 46-8(1953) June.

In addition to the decision of type of reactor, operating power and neutron flux, shielding, control requirements, and experimental areas and services are important in the design of all research reactor facilities. The research facilities must include irradiation facilities, controlled temperature, and means for handling gaseous samples. The tools and equipment for handling research projects are briefly discussed. (J.S.R.)

4459

RADIATION SAFETY FOR A REACTOR. James M. Smith, Jr. Nucleonics 11, No. 6, 41-5(1953) June.

The scope and problems of a reactor radiation protection program are indicated. The problems are discussed by consideration of the factors of reactor design and operation. The more important components of a protection program are tabulated. (J.S.R.)

4460

REACTOR OPERATION. J. M. Harrer. Nucleonics 11, No. 6, 35-40(1953) June.

The components of a reactor control system consist of neutron detectors, indicating instruments, instrument accessories, vertical protective devices, auxiliary instrumentation, flux-control signal amplifiers, power amplifiers, reactivity control, rod-drive components, and operational devices. A description of these components and their instrumentation are given. (J.S.R.)

4461

COOLANTS. O. J. Woodruff, Jr., W. J. McShane, and W. J. Purcell. Nucleonics 11, No. 6, 27-34(1953) June.

The nuclear, thermal, and fluid properties of coolants are reviewed. Water, liquid metals, and gases are the three types of coolants discussed. The system design and components of each type are given, and the advantages and disadvantages of each are discussed. (J.S.R.)

4462

MATERIALS. George E. Evans. Nucleonics 11, No. 6, 18-26(1953) June.

The classification of reactor materials with regard to their function as structural materials, moderators and reflectors, and shielding simplifies a discussion of the factors involved in the selection of specific materials. Physical, mechanical, and nuclear properties of structural materials are tabulated. The nuclear properties of potential moderators and reflectors are discussed and tabulated. The functions of a shield are outlined and properties of heavy concretes are tabulated. (J.S.R.)

4463

THE CONTROL OF A THERMAL NEUTRON REACTOR. R. V. Moore. Proc. Inst. Elec. Engrs. (London) 100, Pt. I, 90-101(1953) May.

The nuclear and thermal characteristics of a gas-cooled graphite-moderated reactor, as they affect the control of such plants, are described, and general principles of design are formulated. Interpretation of these principles in terms of main control elements follows, and examples of mechanisms and circuits involved are given. The special operating phases of starting up and shutting down unique to nuclear plants are analyzed separately. Throughout the paper emphasis is laid on safety considerations, rendered important by the radioactive nature of the heat source and the exponential nature of nuclear power changes. In addition to the provision of properly designed safety devices, it is urged that the biggest safeguards come from a full understanding

of the reactor transient and steady-state characteristics and their careful exploitation in the control-system design. (auth)

4464

NUCLEAR REACTORS AND THEIR APPLICATIONS. John Cockcroft. *Proc. Inst. Elec. Engrs. (London)* **100**, Pt. I, 83-9(1953) May.

Types of nuclear reactors, nuclear characteristics of reactors, technical problems of reactors, control and safety, the Harwell and Chalk River reactors, power reactors, power-breeder reactors, and mobile reactors are discussed. (L.T.W.)

## NUCLEAR TRANSFORMATION

4465

Livermore Research Lab., Calif. Research and Development Co.  
SOME STUDIES OF THE PRODUCTS OF THE HIGH-ENERGY FISSION PROCESS. M. Lindner and R. N. Osborne. Dec. 23, 1952. Decl. with deletions June 1, 1953. 25p. (AECD-3525)

The energy dependence of the formation cross section of certain nuclides formed in fission of U and Th has been studied. Excitation functions in the hundred-Mev region are given for  $\text{Ni}^{66}$ ,  $\text{Zr}^{87}$ ,  $\text{Ag}^{111}$ ,  $\text{Ba}^{131}$ , and  $\text{Ba}^{139}$ . Protons, deuterons, and  $\alpha$  particles from the Berkeley 184-in. f-m synchrocyclotron were used to induce the activities. (auth)

4466

Livermore Research Lab., Calif. Research and Development Co.  
ENERGY-DEPENDENCE OF THE CROSS SECTION FOR THE REACTION  $\text{C}^{12}(\alpha, n)\text{C}^{11}$ . M. Lindner and R. N. Osborne. Jan. 28, 1953. 8p. (MTA-22)

The cross section-vs.-energy curve for the reaction  $\text{C}^{12}(\alpha, n)\text{C}^{11}$  is plotted from threshold to 380 Mev, as determined with polystyrene foils in the  $\alpha$  beam of the 184-in. cyclotron. (G.Y.)

4467

Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
INTEGRAL EQUATION FOR STRIPPING, p.21-7 of PRECISION SCATTERING AND OTHER RESEARCHES. E. Gerjuoy. Mar. 1953. 7p. (NP-4571(p.21-7))

Austern (*Phys. Rev.* **89**, 318(1953)) attempted to clarify the agreement between the results obtained by Butler's theory (*Proc. Roy. Soc. (London)* **A208**, 559(1951)) and from Born approximation by Daitch and French (*Phys. Rev.* **87**, 900(1952)). Austern's conclusions are drawn from an integral equation for the wave function of the problem, in which the Green's function is expressed in momentum space. It is shown here that the integral equation can be more readily interpreted if the Green's function is written in coordinate space. (auth)

4468

Sarah Mellon Scaife Radiation Lab., Univ. of Pittsburgh  
THEORY OF (d,p) AND (d,n) REACTIONS, p.28-53 of PRECISION SCATTERING AND OTHER RESEARCHES. E. Gerjuoy. Mar. 1953. 26p. (NP-4571(p.28-53))

The relationship between Born approximation and Butler's result (*Proc. Roy. Soc. (London)* **A208**, 559(1951)) is considered. Butler's result is rederived by means of standard Green's function techniques, thereby automatically and obviously satisfying the boundary conditions at infinity and at the nuclear radius. To minimize formal complications, the following idealization of the stripping problem is considered: a deuteron, spinless, composed of a spinless proton and neutron, impinges on a fixed center of force which is the initial nucleus. (L.M.T.)

4469

SYMMETRIC FISSION. Tatuya Sasakawa and Tatturo Sawada. *Progr. Theoret. Phys. (Japan)* **9**, 324-6(1953) Mar.

An error in the calculations contained in the paper by N. Bohr and J. A. Wheeler (*Phys. Rev.* **56**, 426(1939)) on the drop model of fission is rectified, and the modified calculations are applied to the determination of the fission energies of  $\text{Th}^{233}$ ,  $\text{Pa}^{233}$ ,  $\text{U}^{235}$ ,  $\text{U}^{236}$ , and  $\text{U}^{239}$ . (L.T.W.)

4470

EVIDENCE FOR THE EMISSION OF A NEUTRINO FOLLOWING THE NUCLEAR CAPTURE OF A NEGATIVE  $\mu$ -MESON. W. F. Fry. *Phys. Rev.* **90**, 999-1000(1953) June 1.

Electron-sensitive G-5 and G-5 2X plates with twice the normal gelatine content were exposed to the Univ. of Chicago cyclotron. The  $\mu$  mesons were separated from the  $\pi$  mesons of the same momentum by utilizing the larger range of  $\mu$  mesons in an absorber. From a study of 17,095  $\mu$ -meson endings in G-5 plates and 2596 in G-5 2X plates, four events were found which gave evidence of neutrino emission. Two of these events were from the  $\text{O}^{16}(\mu^-, \alpha)\text{B}^{12}$  reaction and two from the  $\text{N}^{14}(\mu^-, \alpha)\text{Be}^{10}$  reaction. The energy of the neutrino in each event is estimated from the difference between the rest energy of the  $\mu$  meson and the sum of the threshold energy of the nuclear reaction plus the kinetic energy of the charged nuclear particles. (L.M.T.)

4471

CROSS SECTIONS FOR THE REACTION  $\text{Li}^7(\gamma, \text{T})\text{He}^4$  AT 6.13, 14.8, AND 17.6 MEV. E. W. Titterton and T. A. Brinkley. *Proc. Phys. Soc. (London)* **A66**, 579-80(1953) June 1.

A nuclear-track Li-loaded emulsion was exposed to  $\gamma$  radiation resulting from the bombardment of a Li target with a proton beam of 250  $\mu\text{a}$  at 490 kev. 110 complete  $\text{Li}^7(\gamma, \text{T})\text{He}^4$  events were observed. The cross sections were then determined as a function of energy. (J.S.R.)

4472

AN INVESTIGATION OF (d,p) STRIPPING REACTIONS IV: RESULTS FOR  $\text{Ca}^{40}$  AND  $\text{Sr}^{88}$ . J. R. Holt and T. N. Marsham. *Proc. Phys. Soc. (London)* **A66**, 565-71(1953) June 1.

Angular distributions have been measured of some of the proton groups emitted from targets of natural Ca and Sr under bombardment by 8-Mev deuterons. The theory of the stripping process has been used to enable assignments of spin and parity to be made to the corresponding states of  $\text{Ca}^{41}$  and  $\text{Sr}^{89}$ . The first and second excited states of  $\text{Ca}^{41}$  are thought to be states of single-particle excitation of the odd neutron. In the following list the excitation energies in Mev are accompanied by the shell-model term or the possible spin values and the parity in brackets:

$\text{Ca}^{41}$ : ground state ( $1f_{7/2}$ ), 1.90 ( $2p_{3/2}$ ), 2.42 ( $2p_{1/2}$ ), 3.96 ( $5/2, 3/2^+$ ), 4.76 ( $5/2, 3/2^+$ ), 5.72 ( $5/2, 3/2^+$ ).  
 $\text{Sr}^{89}$ : ground state ( $3/2, 1/2^+$ ), 1.07 ( $1/2, 3/2^-$ ).

The Q-value of the transition to the ground state of  $\text{Sr}^{89}$  is  $4.18 \pm 0.08$  Mev, and this nucleus has excited states at  $1.07 \pm 0.08$ ,  $2.09 \pm 0.08$ ,  $2.66 \pm 0.08$ ,  $4.73 \pm 0.1$  and  $5.46 \pm 0.08$  Mev. (auth)

4473

PHOTONEUTRON REACTION IN  $\text{Ca}^{40}$ . R. Braams and C. L. Smith. *Phys. Rev.* **90**, 995(1953) June 1.

Pure Ca was irradiated with 30-Mev x rays to study the  $\text{Ca}^{40}(\gamma, n)$  reaction. After the decay curve of the radioactivity was corrected for counter background, the half



life of  $\text{Ca}^{39}$  was found to be  $1.00 \pm 0.05$  sec. From Al absorption curves, the maximum energy of the positrons emitted was estimated as  $6.7 \pm 0.5$  Mev. By comparing the number of particles emitted by a similarly shaped but thinner Cu target, activated under the same geometrical conditions in the same apparatus, the estimated induced activity in Ca by the  $(\gamma, n)$  reaction was found to be  $4.7 \times 10^3$  disintegrations/g per roentgen at 30 Mev. (L.M.T.)

4474

THEORY OF POLARIZED PARTICLES IN NUCLEAR REACTIONS. Albert Simon. *Phys. Rev.* **90**, 991(1953) June 1.

In a previous communication (*Phys. Rev.* **90**, 325(1953)) an expression was given for the spin tensor moments arising from a reaction initiated by an unpolarized beam; i.e., one in which all initial tensor moments other than  $q = \kappa = 0$  vanish. This expression is generalized here for the case of an arbitrarily polarized initial beam. (L.M.T.)

4475

GEOMETRY OF THE ANGULAR DISTRIBUTION OF NUCLEAR REACTIONS. Otto Hittmair. *Acta Phys. Austriaca* **7**, 102-9(1953) Apr. (In German)

The geometric, group-theory side of a nuclear reaction of the absorption-emission type is separated from the physical part and treated in detail. The Racah coefficients used are discussed briefly. As a practical application of the formalism the inelastic scattering of neutrons on  $\text{Pb}^{204}$  is calculated on the basis of the statistical nuclear model. (G.Y.)

# PARTICLE ACCELERATORS

4476

A PORTABLE 250-KILOVOLT ACCELERATOR. T. A. Bergstrahl, K. L. Dunning, E. Durand, C. H. Ellison, H. K. Howerton, and W. Slavin. *Rev. Sci. Instr.* **24**, 417-19(1953) June.

A 250-kv linear accelerator of a compact and portable design is described. The high voltage is provided by a commercial Cockcroft-Walton type voltage-multiplier supply. A magnetic-type ion source is used to supply a focused beam in excess of 300  $\mu\text{a}$ . (auth)

4477

LOW VOLTAGE 15-MEV NEUTRON SOURCE. S. G. Forbes, E. R. Graves, and R. N. Little. *Rev. Sci. Instr.* **24**, 424-7 (1953) June.

A compact accelerator has been built which utilizes  $\text{H}^3$  targets bombarded by deuterons. A neutron source strength of  $10^8$  neutrons/sec was achieved. It was possible by using a relatively low accelerating voltage of about 100 kv to arrange the whole assembly so that it could easily be transported from one location to another. (auth)

4478

EFFECT OF MAGNET INHOMOGENEITIES IN THE STRONG-FOCUSING SYNCHROTRON. J. B. Adams, M. G. N. Hine, and J. D. Lawson. *Nature* **171**, 926-7(1953) May 23.

From oscillation considerations it is concluded that great care must be paid to magnet design in a strong-focusing synchrotron. Elaborate methods of assembly will be necessary to get the particles once around the machine, and a very careful control of the field is essential to ensure that they do not hit the walls on later revolutions. Calculations suggest that, in principle, either a linear or non-linear system could be used, provided that technological problems of constructing a sufficiently accurate magnet can be overcome. (L.T.W.)

# RADIATION ABSORPTION AND SCATTERING

4479

Los Alamos Scientific Lab.

DETERMINATION OF INELASTIC COLLISION CROSS SECTIONS. [John R. Beyster.] [nd] 13p. (AECU-2577; LADC-1436)

The sphere transmission method was used for determining the inelastic-scattering cross sections of fission-spectrum neutrons. A fission-neutron source and three different threshold detectors were used, with thin hollow spheres of Cd, Pb, and Fe surrounding the detectors. Transmissions were measured for spherical shells of many thicknesses and a plot of transmission vs. shell thickness for the three elements shows a linear relationship. The effects of background (neutron and  $\gamma$ ), angular asymmetry of counter and source, finite counter size, obliquity, and multiple scattering are discussed. The Fe transmission data are evaluated using a simplified formula for sphere transmission and an inelastic cross section which depends on shell thickness is obtained. (L.M.T.)

4480

Radiation Lab., Univ. of Calif., Berkeley

INTERACTIONS OF FAST ELECTRONS AND POSITRONS WITH MATTER (thesis). Charles E. Violet. Apr. 3, 1953. 76p. (UCRL-2163)

From observations of high-energy electron and positron tracks in nuclear emulsion, the following processes were studied: (1) electron-electron scattering, (2) positron-electron scattering, (3) the ratio of plateau to minimum grain density for electrons, (4) nuclear scattering of electrons and positrons, (5) positron annihilation in flight, (6) pair production by electrons and positrons, and (7) inelastic electron-electron and positron-electron collisions. Experimental results pertaining to (1), (2), (4), (5), and (6) are consistent with the appropriate theories. The ratio of (3) is found to be  $1.087 \pm 0.010$ . Process (7) was not detected. (auth)

4481

A COVARIANT MESON-NUCLEON EQUATION. Stanley Deser and Paul C. Martin. *Phys. Rev.* **90**, 1075-8(1953) June 15.

A relativistic meson-nucleon two-body equation is derived in a form suitable for carrying out renormalization. Methods for determining the interaction kernel and classifying its terms are discussed. A reduction of the equation to three dimensions is carried out and the approximations involved in this procedure are examined. The resulting equation agrees with a corresponding one derived by Tamm-Dancoff methods. (auth)

4482

FOURTH-ORDER CORRECTIONS TO THE SCATTERING OF PIONS BY NONRELATIVISTIC NUCLEONS. John S. Blair and Geoffrey F. Chew. *Phys. Rev.* **90**, 1065-7(1953) June 15.

Fourth-order corrections to the field theoretical phase shifts for pion-nucleon scattering have been calculated for a linear and extended coupling and no nucleon recoil. The results support the use of the "Dancoff approximation," since those processes passing through intermediate states which contain three pions turn out to be much less important than processes involving only one and two pions. (auth)

4483

A NOTE ON MESON-NUCLEON SCATTERING. Robert Karplus, Margaret Kivelson, and Paul C. Martin. *Phys. Rev.* **90**, 1072-5(1953) June 15.

A relativistic meson-nucleon two-body equation applicable

to the elastic nonexchange scattering of negative pions by protons is solved using the lowest-order interaction kernel. The scattering matrix which this equation yields is shown to be unitary. The total cross section calculated from this scattering matrix is finite at threshold and relatively independent of the coupling constant. A plot of the cross section as a function of energy is included. (auth)

4484

THE SMALL ANGLE SCATTERING OF X-RAYS FROM COLD-WORKED SOLIDS. D. L. Dexter. *Phys. Rev.* **90**, 1007-12(1953) June 15.

The small-angle scattering of x rays or thermal neutrons from cold-worked crystals is calculated on the basis of two models, according to which the scattering arises predominantly from the density variation associated either with small cavities or with edge-type dislocations. The elastic distortions surrounding the cavities are unimportant, so that the scattering from cavities in a uniform medium of density  $n$  is the same, to a good approximation, as that from particles (in vacuum) of density  $n$  of the same size as the cavities. Thus the usual formulas of small-angle scattering obtain, the scattered intensity has the familiar gaussian-like dependence on scattering angle, and earlier results on multiple scattering may be applied. Around edge-type dislocations, on the other hand, the density variation is proportional to  $\sin \xi / r$ , where  $\xi$  is the angle measured from the slip direction in the plane perpendicular to the dislocation line and  $r$  is the distance from the dislocation line. This angular variation results in a complete modification of the usual formulas, and, in fact, all of the terms ordinarily present disappear for this case, and conversely. The scattering shows a parabolic increase from zero at small angles, a maximum, and finally a monotonic decrease with increasing scattering angle. There is a large degree of anisotropy in the scattering, depending on the direction of the incident beam relative to the slip and dislocation axes. Multiple scattering from an array of dislocations in even a thick specimen is shown to be negligible. The theory is compared with Blin and Guinier's preliminary experimental results, and it is concluded that dislocations are incapable of explaining their data, although it is expected that under suitable conditions the measurement of the scattering from dislocations should be experimentally feasible. (auth)

4485

THE AZIMUTHAL DISTRIBUTION OF PHOTOELECTRONS PRODUCED BY 0.5-MEV POLARIZED PHOTONS. Frank L. Hereford and Jerome P. Keuper. *Phys. Rev.* **90**, 1043-6(1953) June 15.

The azimuth angular distribution of photoelectrons ejected from Pb by linearly polarized 0.51-Mev photons has been studied. The known correlation between polarization states of annihilation quanta was employed in preparation of the incident beam of polarized photons. Results indicate that for emission from the K shell, the most probable direction is in the plane containing the momentum and polarization vectors of the incident photon. The asymmetry in the distribution thereby produced is slightly greater than that expected from the relativistically computed differential cross section. (auth)

4486

ON THE "OPTICAL METHOD" FOR THE SCATTERING OF HIGH ENERGY PARTICLES BY COMPLEX NUCLEI.

Toshio Marumori. *Progr. Theoret. Phys.(Japan)* **9**, 321-2 (1953) Mar.

The relation between the optical method and the quantum mechanical many-body problem for the scattering of high-energy particles by complex nuclei is discussed. (L.T.W.)

4487

EVALUATION OF PARTICLE LOSS DUE TO MULTIPLE SCATTERING IN FOILS. W. C. Dickinson and D. C. Dodder. *Rev. Sci. Instr.* **24**, 428-31(1953) June.

A graphical integration method is described for the determination of the fraction of a parallel beam of charged particles which is scattered out of a detector when a foil is interposed before the detector. For the case of circular foils and detectors with common normal axes a generalized graph of percentage particle loss is given which illustrates that, although the loss may be quite large, rather small variations of the experimental parameters can greatly reduce it. (auth)

4488

THE SIGN OF THE PHASE SHIFTS IN MESON-NUCLEON SCATTERING. H. A. Bethe. *Phys. Rev.* **90**, 994-5(1953) June 1.

Fermi and collaborators (*Phys. Rev.* **86**, 1056(1952)), in analyzing their experimental results on meson-nucleon scattering in terms of phase shifts, chose the S-wave phase shift positive denoting an attractive interaction, which made the  $P_{3/2}$  interaction negative, i.e., repulsive. All theoretical papers on the subject, however, make the opposite choice of sign. This note points out that there is actually some experimental evidence in favor of the choice of the theorists. (L.M.T.)

4489

DIFFERENTIAL CROSS SECTIONS FOR THE SCATTERING OF 58-MEV  $\pi^+$  MESONS IN HYDROGEN. D. Bodansky, A. Sachs, and J. Steinberger. *Phys. Rev.* **90**, 996-7(1953) June 1.

A beam of 58-Mev  $\pi^+$  mesons passed through an opening in the shielding wall and was deflected by a double-focusing magnet. The incident beam defined by two stilbene counters struck a liquid  $H_2$  target and the scattered mesons were detected in two large rectangular liquid counters. The width of the energy spread at half-maximum was  $\pm 3$  Mev, partly due to initial beam spread and partly due to ionization loss in the  $H_2$ . The effective angular resolution was measured by rotating the detecting telescope through the main beam. Data were taken at six angles and the corrected differential cross sections are presented, both for the center-of-mass and lab. systems. The integrated cross section between 25 and 180° (lab. system) was found to be  $15.3 \pm 1.0$  mb. (L.M.T.)

4490

PHASE-SHIFT ANALYSIS OF THE SCATTERING OF POSITIVE MESONS AT 58 MEV. D. Bodansky, A. M. Sachs, and J. Steinberger. *Phys. Rev.* **90**, 997-8(1953) June 1.

A phase-shift analysis of the experimental results of the scattering of 58-Mev mesons in  $H_2$  (see preceding abstract) is presented, assuming only s and p scattering and, in addition, that the coulomb field is a perturbation on the meson-nucleon interaction at distances smaller than its range. (L.M.T.)

4491

ON THE PENETRATION OF THE ELECTRON. E. Clementel. *Nuovo cimento* (9) **10**, 683-5(1953) May 1. (In Italian)

Loss of energy by an electron by radiation and collision is treated theoretically, both straggling and ionization loss being considered. (G.Y.)

4492

THE PHOTOEFFECT IN A HOMOGENEOUS ELECTRIC FIELD. Herbert Überall. *Acta Phys. Austriaca* **7**, 14-22 (1953) Apr. (In German)

Changes resulting from placing the experimental apparatus in a homogeneous electric field, in the angular



distribution of the photoelectrons and the total cross section of the photoeffect, have been studied. It is shown that the changes are very small even on application of an intense field. (tr-auth)

4493

A SIMPLE DERIVATION OF BHABHA'S SCATTERING EQUATION. Kurt Baumann. *Acta Phys. Austriaca* 7, 96-7 (1953) Apr. (In German)

The author's derivation of Møller's scattering equation (*Acta Phys. Austriaca* 6, 195(1952)) is shown to verify with extraordinary brevity Bhabha's derivation of the scattering cross section of positrons on free electrons (*Proc. Roy. Soc. (London)* A154, 195(1936)). (G.Y.)

# RADIOACTIVITY

4494

Rochester Univ.

RADIATIONS OF NEUTRON-DEFICIENT BARIUM AND CESIUM NUCLIDES. Richard W. Fink and Edwin O. Wiig. May 12, 1953. 5p. (NYO-3839)

CsCl was irradiated with 60-Mev protons to produce 2-hr  $\text{Ba}^{128}$  (the yield of  $\text{Ba}^{128}$  is very small at this energy). The maximum positron energy was measured as  $1.6 \pm 0.2$  Mev, consistent with a predicted decay energy of  $1.8 \pm 0.3$  Mev computed from the  $\beta$ -decay systematics of Coryell (*Ann. Rev. Nuclear Sci.* 2, 305(1953)). Conversion electrons of 0.13 Mev were also present in the decay of  $\text{Ba}^{128}$ . The  $\text{Ba}^{128}$ - $\text{Cs}^{128}$  equilibrium mixture was studied by means of coincidence absorption. A low-energy positron group (maximum energy  $1.1 \pm 0.7$  Mev) in coincidence with one or more  $\gamma$  rays was found. No positron- $\gamma$  coincidences were observed from the 3-Mev positron group and no  $\gamma$  rays of energy  $>0.9$  Mev were found. Conversion electrons of 0.2 Mev were observed. The number of positrons exceeds the number of electrons by a factor of 3 or 4.  $\text{Ba}^{128}$  was found to decay primarily, if not entirely, by electron capture. A half life of  $3.5 \pm 0.6$  min was found for  $\text{Cs}^{128}$ . The following  $\gamma$  lines were assigned to the decay of the  $\text{Ba}^{128}$ - $\text{Cs}^{128}$  mixture: 30 kev (K x ray),  $135 \pm 5$  kev,  $285 \pm 10$  kev,  $455 \pm 5$  kev, and  $965 \pm 20$  kev. (L.M.T.)

4495

Princeton Univ.

EXPERIMENTAL EVIDENCE FOR THE FERMI INTERACTION IN  $\beta$ -DECAY. R. Sherr and J. B. Gerhart. Apr. 8, 1953. 23p. (NYO-3997)

The  $\gamma$ -ray spectra of  $\text{O}^{14}$  and  $\text{C}^{10}$  have been investigated with a NaI scintillation spectrometer. A value of  $2.30 \pm 0.03$  Mev was found for the  $\text{O}^{14}$  nuclear  $\gamma$  ray.  $\text{C}^{10}$  has two  $\gamma$  rays with energies  $723 \pm 15$  and  $1033 \pm 30$  kev; the number of quanta per disintegration are  $0.99 \pm 0.08 \times 10^{-2}$  and  $1.65 \pm 0.20 \times 10^{-2}$ , respectively. The 1033-kev  $\gamma$  ray is associated with a weak positron transition to the 1.74-Mev level in  $\text{B}^{10}$ . There are less than  $10^{-3}$  transitions per disintegration to the 2.15-Mev level of  $\text{B}^{10}$ . By combining results with those of heavy particle reactions and using the predictions of the charge multiplet theory on the energies of the analog states, it is concluded that the  $\text{O}^{14}$  decay and the weak  $\text{C}^{10}$  branch to the 1.74 Mev of  $\text{B}^{10}$  are allowed favored  $0 \rightarrow 0$  (No) transitions. From the  $\text{C}^{10}$  data it is found that the ratio of the Fermi to the Gamow-Teller interactions constants ( $G_F^2/G_{GT}^2$ ) is  $0.79_{-0.11}^{+0.21}$  for LS coupling, and  $0.44_{-0.07}^{+0.16}$  for jj coupling. (auth)

4496

Radiation Lab., Univ. of Calif., Berkeley

PATTERNS IN ALPHA SPECTRA OF EVEN-EVEN NUCLEI. Frank Asaro and I. Perlman. May 13, 1953. 7p. (UCRL-2214)

Some definite regularities in the spectra of even-even  $\alpha$  emitters are described. Most of the data were obtained over

the range of elements from Ra to Cm. Identification of energy states recurring generally and designation of the  $\alpha$  transitions leading to these states are discussed. (L.T.W.)

4497

THE SERIES OF SUCCESSIVE RADIOACTIVE TRANSITIONS  $\text{Zr}^{96} - \text{Nb}^{95} - \text{Mo}^{95}$ . V. S. Shpinel'. Translated from Zhur. Eksptl'. i Teoret. Fiz. 21, 1370-5(1951). 10p. (AEC-TR-1507)

An abstract of this article appears in *Nuclear Science Abstracts* as NSA 6-3724.

4498

STUDY OF RADON ENCLOSED IN THE HALIDE MICROCRYSTALS OF NUCLEAR PHOTOGRAPHIC EMULSIONS. Léopold Vigneron, Raymond Chastel and Jeannine Génin. *Compt rend.* 236, 2053-5(1953) May 27. (In French)

An Ilford C2 emulsion, in which the halide grains have a radius of approximately  $10^{-5}$  cm, was impregnated with Ra and then washed after 48 hr. A part of the Rn formed remained enclosed in the crystals and that which did escape did so slowly. The activity of the Rn is plotted against time. (tr-auth)

4499

GAMMA-RAY OUTPUT OF RADIUM. A. Ghosh, J. Kastner, and G. N. Whyte. *Nucleonics* 11, No. 6, 70-2(1953) June.

The  $\gamma$ -ray output from 1 mg of Ra incased in 0.5 mm of Pt has been remeasured. The value obtained,  $8.44 \pm 0.07$  r/mg/hr at 1 cm, agrees well with previous measurements. (J.S.R.)

4500

CONTINUOUS GAMMA-RADIATION ACCOMPANYING INTERNAL CONVERSION IN  $\text{Ba}^{137m}$ . Harry B. Brown and Robert Stump. *Phys. Rev.* 90, 1061-3(1953) June 15.

A weak continuous  $\gamma$  radiation accompanying internal conversion has been observed from the decay of the isomeric state of  $\text{Ba}^{137}$ . The probability of this emission is  $1.17 \pm 0.27 \times 10^{-3}$  photons in the energy range 50 to 100 kev per conversion electron, and  $3.4 \pm 0.8 \times 10^{-3}$  photons in the energy range 50 to 200 kev per conversion electron. The angular distribution of the continuous radiation in the energy range 50 to 200 kev has been measured at angles from  $90$  to  $160^\circ$  with the electron direction. There appears to be no deviation from isotropy. (auth)

4501

BETA-SPECTRUM OF ARSENIC-71. Hugo Atterling and Sigvard Thulin. *Nature* 171, 927(1953) May 23.

The Kurie plot of the positron spectrum of  $\text{As}^{71}$  gives an upper limit of  $815 \pm 20$  kev. There is also evidence of a weak component having the end point at  $\sim 300$  kev. In addition to Auger lines, 3 conversion electron lines were found at 12.2, 22.0, and 164 kev. The former two are interpreted as the K and L lines of a  $\gamma$  ray of energy  $23.3 \pm 0.3$  kev. The 164-kev line is interpreted as arising from the K and L conversion of a  $\gamma$  ray of energy 175 kev. The half life of  $\text{As}^{71}$  was found to be  $65 \pm 5$  hr. (L.T.W.)

4502

AN INVESTIGATION OF THE  $\beta$ -PARTICLE SPECTRUM OF MESOTHORIUM 2. J. Kyles, C. G. Campbell, and W. J. Henderson. *Proc. Phys. Soc. (London)* A66, 519-32 (1953) June 1.

Using a permanent magnet double  $\beta$ -ray spectrometer, the  $\beta$ -particle spectrum of  $\text{Ac}^{228}$  has been examined, and partial spectra with end points at 2.18, 1.85, 1.70, 1.11, 0.64 and 0.45 Mev have been found. A list of conversion lines is given with an analysis in terms of  $\gamma$  rays. A level scheme is put forward which is consistent with the  $\beta$ - $\beta$ ,  $\beta$ - $\gamma$ , and  $\gamma$ - $\gamma$  coincidence measurements made. The ground-to-ground state transition is unobserved, the partial spectrum of highest energy corresponding to an excited state at 57 kev which is metastable with a half life greater than  $10^{-2}$  second. (auth)



4503

FORMATION AND DECAY OF  $\text{Mo}^{93\text{m}}$ . C. W. Forsthoef, R. H. Goeckermann, and R. A. Naumann. *Phys. Rev.* **90**, 1004-5(1953) June 1.

$\text{Mo}^{93\text{m}}$  was produced by the (p,n) reaction on  $\text{Nb}^{93}$ . Evidence of decay of  $\text{Mo}^{93\text{m}}$  by isomeric transition was obtained by studying the associated x rays. The internal conversion electrons were examined on a precision  $180^\circ$   $\beta$  spectrometer and the spectra obtained agree well with that obtained by others. From the measured K/L ratio and the ratio of the number of K electrons in the three conversion lines, K conversion coefficients were calculated for the three cascade  $\gamma$ 's. From these coefficients and the new K/L ratio for the 684-keV  $\gamma$ , an M1 assignment was made for the 684-keV  $\gamma$  and either E2 or M1 for the 1479-keV  $\gamma$ . (L.M.T.)

4504

INTERFERENCE TERMS OF THE ELECTRON-NEUTRINO ANGULAR CORRELATION. Masato Morita. *Phys. Rev.* **90**, 1005-6(1953) June 1.

The electron-neutrino angular correlation functions in the allowed and first-forbidden transition of  $\beta$  decay for the Fermi theory were deduced. Since the square terms were derived by Greuling and Meeks (*Phys. Rev.* **82**, 531(1951)), only the interference terms are recorded here. When the properties of the transformation coefficients are used, it is verified that the interferences between the nuclear matrix elements with different ranks all vanish, just as in the case of the correction factors. (L.M.T.)

4505

DECAY OF  $\text{Ga}^{64}$  AND  $\text{Ga}^{65}$ . Bernd Crasemann. *Phys. Rev.* **90**, 995-6(1953) June 1.

$\text{Ga}^{64}$  was found to decay by positron emission with a half life of  $2.6 \pm 0.1$  min. The activities were produced by the  $\text{Zn}^{64}(\text{p},n)$  reaction using 9.5-MeV protons, by the  $\text{Zn}^{64}(\text{d},2n)$  reaction using 19-MeV deuterons, and by the  $\text{Cu}^{63}(\alpha,3n)$  reaction using 40-MeV  $\alpha$  particles. Positron activities from the Ga fractions of Zn bombarded with deuterons and Cu bombarded with  $\alpha$  particles showed a half life of 15 min, characteristic of  $\text{Ga}^{65}$ . Two groups of positrons were observed: one of  $2.52 \pm 0.05$  MeV, abundance 10%, and  $\log ft$  6.0; and another of  $2.1 \pm 0.1$  MeV, abundance of 90%, and  $\log ft$  4.7. (L.M.T.)

4506

THE PHOSPHORESCENCE OF THORIA. C. E. Mandeville and H. O. Albrecht. *Phys. Rev.* **90**, 992-3(1953) June 1.

A continuous "natural" luminescence in thoria resulting from the self-absorption of the internally emitted nuclear radiations was observed. When a small piece of crystalline thoria was placed before the slit of a small Hilger quartz spectrograph, no noticeable darkening of the photographic plate was observed; however, when the crystal was bombarded by  $\sim 15$  mc of Po  $\alpha$ 's a spectrogram showing an emission band at  $\sim 4500$  Å was obtained. The decay of  $\alpha$ -particle-induced phosphorescence of thoria was observed by superposing a fast-decaying  $\alpha$ -particle-excited phosphorescence upon the "natural" luminescence and then subtracting the "natural" luminescent intensity. (L.M.T.)

4507

ON THE RELATIONS BETWEEN BETA-DECAY NUCLEAR MATRIX ELEMENTS. Masami Yamada. *Progr. Theoret. Phys. (Japan)* **9**, 268-72(1953) Mar.

Ahrens and Feenberg (*Phys. Rev.* **86**, 64(1952)) found several relations between the first-forbidden  $\beta$ -decay nuclear matrix elements. In this paper the relations are extended to the general forbiddenness and compared with experiment. (auth)

4508

ANGULAR CORRELATIONS FROM LIQUID SOURCES.

R. V. Pound and A. Abragam. *Phys. Rev.* **90**, 993-4(1953) June 1.

In a previous note (*Phys. Rev.* **89**, 1306(1953)) discrepancies between expected and observed angular correlations, such as that of the  $\alpha$ - $\gamma$  cascade of  $\text{Th}^{228}$ , were shown to be attributable to the coupling of the nucleus in its intermediate state to crystalline electric fields. Results more nearly like those expected are found when the source is put into the liquid state, usually as an aqueous solution. This note shows that discrepancies between expected and observed angular correlations from liquid sources, such as that reported for  $\text{Rh}^{106}$  by Kraushaar and Goldhaber (*Phys. Rev.* **89**, 1081(1953)), can result from the electric quadrupole moment in the intermediate state of the nucleus. (L.M.T.)

4509

UPPER LIMIT FOR A SECOND BETA-TRANSITION IN  $^{114}\text{In}$  AND THE POSITION OF THE FIRST EXCITED STATE IN  $^{114}\text{Sn}$ . R. H. Nussbaum and R. van Lieshout. *Physica* **19**, 451-3(1953) May. (In English)

Coincidence measurements and extrapolations on graphs of the excitation energy of the first excited states of even-even nuclei indicate that the intensity of an  $\text{In}^{114}$   $\beta^-$  decay leading to the first excited state of  $\text{Sn}^{114}$  is of the order of  $3 \times 10^{-3}$ /disintegration. This intensity ratio is in good agreement with the experimental one, indicating that the assumption about the position of the  $2^+$  first excited state in  $\text{Sn}^{114}$  at  $\sim 1.2$  MeV cannot be too far in error. Consideration of the K-capture decay suggests that the 556-keV  $\gamma$  transition is the result of deexcitation of the first excited level in  $\text{Cd}^{114}$ . (G.Y.)

4510

ON THE RADIOACTIVE DECAY OF  $^{112}\text{Pd}$  AND  $^{112}\text{Ag}$ . R. H. Nussbaum, A. H. Wapstra, N. F. Verster, and H. Cerfontain. *Physica* **19**, 385-90(1953) May. (In English)

The radioactive decay of  $\text{Pd}^{112} \rightarrow \text{Ag}^{112} \rightarrow \text{Cd}^{112}$  has been investigated both with a  $\beta$ - $\gamma$  coincidence apparatus and with a single-channel NaI(Tl) scintillation spectrometer. A short description of the main features of the instruments is given. In the  $\text{Pd}^{112}$   $\beta^-$  decay a  $\gamma$  ray of about 18 keV was found. Coincidence absorption measurements with  $\text{Ag}^{112}$  yielded a complex  $\beta^-$  spectrum with a maximum energy of  $4.1 \pm 0.3$  MeV ( $\sim 25\%$ ), leading to the ground state of  $\text{Cd}^{112}$ , and at least two other components of  $\sim 3.5$  and  $\sim 1.5$  MeV with roughly equal intensities. The main  $\gamma$  transition in  $\text{Ag}^{112}$  has an energy of 620  $\pm$  15 keV, while there is evidence for the presence of several more weak  $\gamma$  lines in the energy ranges below 500 keV and between 1 and 2 MeV. A decay scheme and spin assignments for the levels which belong to the principal modes of decay are proposed. Redetermination of  $\alpha_K$  of the 87 keV  $\gamma$  ray in  $\text{Pd}^{100}$  yielded  $9.2 \pm 1.5$ . (auth)

4511

MEASUREMENTS ON THE CONTINUOUS BETA-SPECTRA, THE CONVERSION LINES AND THE AUGER-LINES OF  $\text{U}(\text{X}_1 + \text{X}_2)$ . P. H. Stoker, M. Heerschap, and Ong Ping Hok. *Physica* **19**, 433-44(1953) May. (In English)

Measurements on the  $\beta$  spectra of  $\text{U}(\text{X}_1 + \text{X}_2)$  ( $\text{Th}^{234} + \text{Pa}^{234}$ ) in a 16.2-cm double-focusing spectrometer, (resolution of 1.5%) are described. Of the electron lines 25 could be ascribed to 11  $\gamma$  rays, while the lines below 21 keV could be interpreted as L Auger lines on account of energy and intensity considerations. The Fermi-Kurie analysis of the continuous  $\beta$  spectra gave 5 components with end points at 2305, 1500, and 580 keV for  $\text{UX}_2$  and at 193 and 103 keV for  $\text{UX}_1$ . The relative intensities were



respectively 90, 9, and 1% for  $UX_2$  and 66 and 34% for  $UX_1$ . The 91-keV  $\gamma$  ray of  $UX_1$  is  $E_2$ , while the 810-keV  $\gamma$  ray of  $UX_2$  may be  $M_1$ . A tentative disintegration scheme with spin and parity assignments to some of the levels is discussed. (auth)

4512

DIRECTIONAL CORRELATION MEASUREMENTS ON SUCCESSIVE NUCLEAR GAMMA RAYS IN  $Hf^{177}$ . T. Wiedling. *Arkiv Fysik* 6, 39-48(1953).

$Lu^{177}$  (6.9-day) of high specific activity was obtained by irradiation of "spec-pure"  $Lu_2O_3$  with slow neutrons for three weeks. Scintillation counters employing 1P21 photomultipliers and NaI(Tl) crystals mounted in small light-tight  $H_2O$ -cooled houses were used as detectors for the  $Hf^{177}$   $\gamma$  radiation. The spectrum of  $Hf^{177}$  showed a 65-keV K x ray, the two strong  $\gamma$  peaks of 112 and 206 keV, and a weak cross-over  $\gamma$  of 318 keV (intensity  $\sim 10^{-2}$  of the 206-keV  $\gamma$  intensity). The x ray was partly discriminated against and partly absorbed by Sn. From the experimental results obtained, along with previous theoretical investigations, it is concluded that the 206-keV  $\gamma$  is  $E_1$ , the 12-keV  $\gamma$  is  $E_2$ , and the cross-over  $\gamma$  is  $E_1$ . (L.M.T.)

#### RARE EARTHS AND RARE-EARTH COMPOUNDS

4513

MAGNETIC RESONANCE IN  $LaMnO_3$  AT LOW TEMPERATURE. Toshihiko Okamura and Yuzo Kojima. *Physica* 19, 412-14(1953) May. (In English)

Magnetic resonance in  $LaMnO_3$  was studied from room temperature down to the temperature of liquid N at microwave frequencies of 23,500 and 9450 Mc. Effects of frequency and temperature on the g-factor and line width are discussed. (G.Y.)

4514

CRYSTAL FIELD THEORY IN THE RARE EARTHS. R. J. Elliott. *Revs. Modern Phys.* 25, 167-9(1953) Jan.

The paramagnetic properties (in particular the resonance data) of the rare-earth ethyl sulfates are considered in the light of a theory in which each ion is assumed to be in a static electric field of  $C_{3h}$  symmetry. It is found that this is consistent with the observations in Ce ethyl sulfate, and it is possible to solve that problem to find the magnitude of the interaction of this field with an ion. It is then shown that similar fields give good agreement with the observations in other salts. (auth)

#### SHIELDING

4515

STUDY OF SOME SPECIAL CONCRETES FOR PROTECTION. J. Bourgeois, A. Ertaud, and J. Jacquesson. *J. phys. radium* 14, 317-22(1953) May. (In French)

The attenuation of neutrons passing through some concretes designed for shielding, by using the radiation of thermal neutrons from the scattering column of the Châtillon pile, has been studied. The neutrons are characterized by the macroscopic effective transport and capture cross sections. The concretes studied were ordinary concrete, concrete with  $B_4C$ , borax concrete, concrete with serpentine and tourmaline, concrete with barite and  $B_4C$ , and concrete with serpentine and Fe. The diffusion lengths varied from 5.62 cm (ordinary concrete) to 1.15 cm (concrete with serpentine and tourmaline). The density of the concretes varied from 2.3 to 3.5 g/cm<sup>3</sup>. (tr-auth)

#### SPECTROSCOPY

4516

A BAND-SYSTEM OF RADIUM CHLORIDE. Albin Lagerqvist. *Arkiv Fysik* 6, 141-2(1953).

Spectrograms of  $RaCl_2$  were taken with a 4-m Rowland grating in a Paschen mounting. The band spectrum of  $RaCl_2$  consists of two very intense red-shaded sequences, one at 6763 Å, the other at 6498 Å. Just in front of the strongest sequence—that at 6498 Å—some rather faint bands are visible beginning at 6489 Å. Besides the two strong sequences there is another very weak one beginning at 6607 Å. The structure of the 6498 sequence shows clearly a  $\Pi-\Sigma$  transition, with the R heads beginning at 6489 Å and the Q heads at 6498 Å. (auth)

#### THEORETICAL PHYSICS

4517

THE TAMM-DANCOFF FORMALISM AND THE SYMMETRIC PSEUDOSCALAR THEORY OF NUCLEAR FORCES. Abraham Klein. *Phys. Rev.* 90, 1101-15(1953) June 15.

The general method of deducing the Tamm-Dancoff equalities formalism, as generalized by Lévy, from the relativistic two-body equation of Bethe-Salpeter and Schwinger is given. Only processes which are finite *ab initio* are considered. The essence of the procedure is the relation between a set of conventional matrix elements of the Tamm-Dancoff formalism and the Feynman diagram which summarizes them; this relationship provides a convenient guide for enumerating all matrix elements of a specified type and precludes the possibility of omission of any members of the set. Rules are also given for writing down any matrix element. The method is then applied to the derivation of the fourth-, sixth-, and eighth-order adiabatic potentials on the symmetrical pseudoscalar-pseudoscalar theory. Some discrepancies with the results of Lévy are noted. In connection with the fourth-order potential these are, first, that a more careful treatment of the energy denominators of the leading two-pair terms brings to light contributions that cancel with all other two-pair matrix elements that are of relative order  $\mu/M$  compared to the leading ones; second, that the one-pair terms do not vanish but yield a repulsive interaction which substantially alters the qualitative picture of the fourth-order potential; third, that for the no-pair terms the result should agree with the previously calculated fourth-order potential for the pseudoscalar-pseudovector theory. The sixth- and eighth-order results are also in disagreement with Lévy. Finally, an analysis of the problem of many-particle forces is given and explicit results obtained for the leading terms of the three- and four-particle forces as well as for certain smaller contributions to the three-particle interaction. (auth)

4518

THE USE OF THE TAMM-DANCOFF METHOD IN FIELD THEORY. Freeman J. Dyson. *Phys. Rev.* 90, 994(1953) June 1.

The Tamm-Dancoff method, as ordinarily used in problems of field theory, runs into serious difficulties when applied to problems connected with the vacuum self-energy. This note presents a simple modification of the method which avoids this difficulty. (L.M.T.)

4519

ON THE GAGE INVARIANCE OF THE NEUTRAL VECTOR MESON THEORY. R. J. Glauber. *Progr. Theoret. Phys. (Japan)* 9, 295-8(1953) Mar.

The neutral vector meson theory is discussed in such a way that, by exploiting its similarity to quantum electrodynamics, the transition to vanishing meson rest mass is simplified. In particular, the gage invariance of electrodynamics is shown to be a special case of an invariance holding more generally in the meson theory. (auth)



4520

ON THE TRANSITION AMPLITUDE IN QUANTUM ELECTRODYNAMICS. Shoichi Hori. Progr. Theoret. Phys. (Japan) 9, 299-311(1953) Mar.

A set of orthonormal states is constructed by operating (free) photon-, electron-, and positron-creation operators one after another to the (free) vacuum state  $\Psi_0$ . Any state  $\Psi[\sigma]$  can be expanded in terms of these orthonormal states. An equation is derived in a covariant form which is satisfied by a coefficient of the expansion which is a functional of  $\sigma$  and whose absolute square may be interpreted as the transition probability. The procedure may be regarded as the transition to the Fock space. Relation to the S-matrix is also discussed. (auth)

4521

A QUANTUM THEORY OF BOSON ASSEMBLIES. II. A CLASSICAL APPROACH TO MANY-BOSON PROBLEMS. Toshiyuki Nishiyama. Progr. Theoret. Phys. (Japan) 9, 245-67(1953) Mar.

Some collective behaviors of boson assemblies are described in terms of the classical density operator and the classical velocity operator. These two classical quantities are introduced by taking average of the quantized operators with respect to Heisenberg wave packets. Equations of these two quantities are determined, and the transport equations are obtained. Thus the assembly is described as a fluid having the quantum mechanical pressure tensor. The collective behavior of the assembly in question is analyzed by applying the theory of sound waves. Such an approximate treatment permits the assembly in question to be regarded as the assembly of oscillation quanta. When a particle is projected into the assembly with the velocity  $v_0$  which is larger than the sound speed of the medium, suffering the collective response of the remainder of the bosons, the particle is decelerated and emits sound quanta. These processes are analyzed by a classical treatment. Further the interaction of every particle in the assembly with the field of the collective oscillation representing behaviors of the remainder of the assembly is considered. The self-energy of the particle and the Möller interaction between particles are obtained according to the interaction representation of Tomonaga and Schwinger as well as the canonical transformation of Bloch and Nordsieck. (auth)

4522

ON THE REACTION OF THE MESONIC PROPER FIELD. Shigeo Goto, Rokuo Kawabe, and Masashi Takasu. Progr. Theoret. Phys. (Japan) 9, 312-20(1953) Mar.

The processes of pion-nucleon scattering and photoproduction of positive pions are calculated with the pseudovector coupling in the pseudoscalar theory by using the corrected nucleon propagation function obtained from the prescription of the non-singular theory proposed by Kamefuchi and Umezawa. It is shown by this calculation that, in this non-singular theory, (i) the pole appears in the corrected propagation function and (ii) difficulties with respect to the gauge invariance happen. The circumstances of these problems and the methods to overcome them are discussed. (auth)

4523

ELECTROMAGNETIC SHIFTS OF ENERGY LEVELS AND C-MESON HYPOTHESIS. Osamu Hara. Progr. Theoret. Phys. (Japan) 9, 322-3(1953) Mar.

The C-meson field was proposed by A. Pais (Phys. Rev. 68, 227(1945)) and S. Sakata and O. Hara (Progr. Theoret. Phys. (Japan) 2, 30(1947)) to solve the divergence difficulties of the self-energy problem of charged particles. The effect of the C-meson field on the  $2S_{1/2}$ - $2P_{1/2}$  level shift is examined theoretically. (L.T.W.)

4524

SPIN ORBIT COUPLING AND THE MESONIC LAMB SHIFT. R. Chisholm and B. Touschek. Phys. Rev. 90, 763-5(1953) June 1.

It is shown that the self-energy corrections for a nucleon moving in a scalar potential well lead to a strong spin-orbit coupling for pseudoscalar mesons. The effect is, however, opposite in sign to that required by the nuclear shell model. (auth)

4525

SPIN-ORBIT COUPLING ACCORDING TO THE PSEUDOSCALAR THEORY. Gernot Eder. Acta Phys. Austriaca 7, 91-5(1953) Apr. (In German)

Under the assumption of pseudoscalar mesons with pseudovector coupling, the effective potential of an additional nucleon is calculated. The spin-orbit coupling obtained is in qualitative agreement with experiment, but it would be modified at higher approximations. (tr-auth)

4526

REPRESENTATION BY SPHERICAL FUNCTIONS OF SOLUTIONS OF THE WAVE EQUATIONS OF PARTICLES WITH SPIN; CASE OF SPIN- $1/2$  AND -1 PARTICLES. Gérard Petiau. Compt. rend. 236, 1750-3(1953) May 4. (In French)

The determination of solutions of the wave equations of the Dirac electron for the case of a radial electrostatic potential by means of spherical functions is well known. For the case of spin-1 particles, this problem can be solved only partially by surmounting great analytical difficulties. The author here applies to the case of spin- $1/2$  and -1 particles a method permitting the determination of solutions of the wave equations by means of spherical functions for particles of arbitrary spin for the case where the exterior scalar potential is constant. (tr-auth)

4527

DEFINITION OF THE RELATIVISTIC PARTICLE-ANTIPARTICLE WAVE FUNCTION. Kurt Baumann. Acta Phys. Austriaca 7, 98-101(1953) Apr. (In German)

Consideration of scattering according to the Salpeter-Bethe representation shows that only the relativistic two-particle wave function of Karplus and Klein, not that of Schwinger and Salpeter-Bethe, is suitable for describing bound states of a fermion with an antifermion of the same type. (tr-auth)

4528

ON THE RELATION BETWEEN PHASE SHIFT, ENERGY LEVELS, AND THE POTENTIAL. Res Jost and Walter Kohn. Kgl. Danske Videnskab. Selskab Mat. fys. Medd. 27, No. 9, 1-19(1953). (In English)

A method recently developed by Gel'fand and Levitan (Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 15, 309(1951)) is adapted to the problem of determining a central potential from the "spectral function" corresponding to a given angular momentum. (The spectral function incorporates the phase shift, binding energies, and  $m$  additional free parameters if there are  $m$  bound states.) Two applications are given: An explicit expression is deduced for the totality of potentials with the same phase shift and binding energies as a given potential. Further it is shown that for a given phase shift the position of the bound states is entirely arbitrary and an explicit example is given which illustrates this fact. Implications for the interpretation of neutron-proton scattering data are discussed. (auth)



## URANIUM AND URANIUM COMPOUNDS

4529

THE VAPOR PRESSURE AND CRITICAL CONSTANTS OF URANIUM HEXAFLUORIDE. George D. Oliver, H. T. Milton, and J. W. Grisard. *J. Am. Chem. Soc.* **75**, 2827-9 (1953) June 20. (cf. NSA 6-2060)

Vapor pressure measurements were made on  $UF_6$  from  $0^\circ$  to the critical point. The vapor pressure of the solid is represented by the equation:  $\log_{10} P_{mm} = 6.38363 + 0.0075377t - 942.76/(t + 183.416)$ . Pressure data on the liquid from  $64$  to  $116^\circ$  are represented by equation:  $\log_{10} P_{mm} = 6.99464 - 1126.288/(t + 221.963)$ , and above  $116^\circ$  by equation:  $\log_{10} P_{mm} = 7.69069 - 1683.165/(t + 302.148)$ . Critical constants determined from experimental data are:  $t_c$ ,  $230.2 \pm 0.2^\circ$  and  $P_c$ ,  $45.5 \pm 0.5$  atm. Calculated  $\Delta H_v$  at the triple point,  $64.02 \pm 0.05^\circ$ , was  $6.82$  kcal/mole. Calculated deviations from ideality were  $0.0062$  at  $25^\circ$  and  $0.043$  at  $64.02^\circ$ . (auth)